

14P

A Reproduced Copy
OF

N71-36574

Reproduced for NASA
by the
NASA Scientific and Technical Information Facility

Reproduced by
**NATIONAL TECHNICAL
INFORMATION SERVICE**
Springfield, Va. 22151

PROJECT TECHNICAL REPORT

STEADY-STATE ATTITUDE CONTROL PROPULSION SYSTEMS
COMPUTER PROGRAM DOCUMENTATION AND USER'S MANUAL
VOLUME II
MSC/TRW TASK 705-1

NAS 9-8166

June, 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

FACILITY FORM 602	<u>N71-36574</u> (ACCESSION NUMBER)	
	<u>277</u> (PAGES)	<u>G3</u> (THRU)
	<u>CR-115185</u> (NASA CR OR TMX OR AD NUMBER)	<u>08</u> (CODE)
		(CATEGORY)

OFFICE OF PRIME RESPONSIBILITY

EP4

CR-115185

17618-H204-RO-00

PROJECT TECHNICAL REPORT

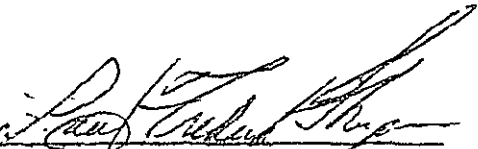
STEADY-STATE ATTITUDE CONTROL PROPULSION SYSTEMS
COMPUTER PROGRAM DOCUMENTATION AND USER'S MANUAL
VOLUME II
MSC/TRW TASK 705-1

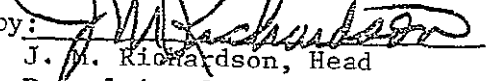
NAS 9-8166

June, 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
P. F. Thompson
R. C. Turley
Propulsion Systems Section
Chemical and Mechanical Systems Department

Approved by: 
P. F. Thompson, Task Manager
MSC/TRW Task 705-1

Approved by: 
J. M. Richardson, Head
Propulsion Systems Section

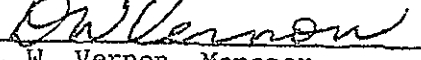
Approved by: 
D. W. Vernon, Manager
Chemical and Mechanical
Systems Department

TABLE OF CONTENTS

	<u>Page</u>
1. INTRODUCTION	1
2. PROGRAM DESCRIPTION.	3
2.1 Program Definition.	3
2.2 Method of Solution	4
3. ATTITUDE CONTROL PROPULSION SYSTEM COMPUTER PROGRAM LISTING . .	7
3.1 Element Table	8
3.2 Subroutines	13
3.2.1 SSPIPE	13
3.2.2 ADIAB	16
3.2.3 BCDINT	19
3.2.4 BDATA	21
3.2.5 BEGS	23
3.2.6 BETA	32
3.2.7 BINSER.	33
3.2.8 BLK 1	36
3.2.9 BLK 2	40
3.2.10 BPROPG	44
3.2.11 BPROPL	46
3.2.12 CDDATA	48
3.2.13 CHAM	57
3.2.14 CHOICE	63
3.2.15 CMON	67
3.2.16 DP2R	72
3.2.17 DRIVER	73
3.2.18 FCOMP 1	75

Table of Contents Cont'd

	Page
3.2.19 FCOMP 2	77
3.2.20 FCOMP 3	79
3.2.21 GATHER	81
3.2.22 HEATEX	88
3.2.23 HEATX	96
3.2.24 HPTCP	100
3.2.25 HPTCV	102
3.2.26 HPTD	104
3.2.27 HPTTC	110
3.2.28 HPTV	115
3.2.29 HYDRO	121
- 3.2.30 H2OH2	124
3.2.31 INITIAL	126
3.2.32 INTEG	128
3.2.33 INTERP	130
3.2.34 INTERP 2	132
3.2.35 ISOTH	134
3.2.36 JUNCL	137
3.2.37 LATENT	140
3.2.38 LEGS	142
3.2.39 NUSLET	150
3.2.40 OUTPRC	152
3.2.41 OXYGEN	159
3.2.42 PACK	162
3.2.43 PBL	164
3.2.44 PERFOR	167

Table of Contents Cont'd	Page
3.2.45 PIPL	172
3.2.46 PREG	176
3.2.47 PROPTY	180
3.2.48 PTHEAT	182
3.2.49 R2DP	186
3.2.50 SAT.	187
3.2.51 SQZB	189
3.2.52 TANK	191
3.2.53 TANKD.	194
3.2.54 THERM.	199
3.2.55 TPOCB 1.	208
3.2.56 TPOCB 2.	237
3.2.57 TRWDAT.	246
3.2.58 TRWLOD	249
3.2.59 VALVG	257
3.2.60 VALVL.	260
3.2.61 WRITE	262
3.2.62 FEEDB.	272
3.3 PROGRAM STORAGE	265
4. REFERENCES	274

ILLUSTRATIONS

ACPS General Flowchart.	5
Flowchart for Subroutine Gather	6

1. INTRODUCTION

The purpose of this document is to provide the user with a listing of the Steady-State Attitude Control Propulsion System Computer Program (SSACPS). This document is to be used in conjunction with Volume 1, Reference 2, and as a supplement to the Engineer's Manual, Reference 1. Reference 1 contains detailed information on each component model. The SSACPS was developed as a general computer simulation model capable of modeling a large variety of attitude control propulsion systems (ACPS). This model has been developed under MSC/TRW Task 705-1 for use on MSC's Univac 1108 Computer along with the ACPS transient Computer Program.

The SSACPS was developed with the capability to simulate operation of ACPS components connected in a large variety of configurations. The components are connected within the program by the user using input data to define initial and operating conditions. The component models consist of gas generators, monopropellant and bipropellant combustors; lines including adiabatic, isothermal, and heat transfer with friction-liquid/gas; heat exchangers; junctions; regulators; pressure boundaries; and liquid and gas valves. The system model uses hydrogen and oxygen properties from detailed NBS property subroutines. The data are input through the numerical input subroutine TRWLOD and the system equations are solved by the nonlinear equation solver: TRW BEGS. The constraint equations for each component set of equations and the state variables are selected by the user. This allows a great deal of flexibility in solving for either fluid state points or component dimensions.

2. PROGRAM DESCRIPTION

2.1 Program Definition

The SSACPS is a flexible steady-state attitude control propulsion system simulation computer program. The program consists of engineering equations simulating the fluid states using properties of hydrogen and oxygen. The combustor products of combustion are modeled using curve fit data. ACPS components are available for combination in any type of ACPS simulation.

The SSACPS program is stored on a PCF tape which contains the entire program. The program includes subroutines which model individual components, thermodynamic property data, a nonlinear equation solver, and a set of driver subroutines.

The ACPS program main driver Subroutine, SSPIPE, is shown in figure 1. SSPIPE initializes the line calculations, reads input data and sets up the basic call sequences to exercise the entire program. SSPIPE calls subroutine BEGS (routine which solves a system of implicit equations) and BEGS in turn calls Subroutine GATHER, figure 2, which sets up the ACPS component models into the desired system configuration as input by the user. GATHER also sets up the state variables and the functional constraint equations and returns these values to subroutine BEGS where the state variables are varied in order to minimize the ACPS functional constraint equations. Control is then returned to SSPIPE and the output processor, OUTPRC, prints the ACPS case output. The time may be incremented at this point for integration purposes or the program terminated.

TRWLOD (card input) input is used to enter the component data and system configuration. TRWLOD is described in Reference 2 Section 4.8

and the description of the card inputs is presented in Reference 2
Section 3.1.3.

2.2 Method of Solution

The theory and mathematical derivations for this program are described in Reference 1.

Program Driver (SSPIPE)

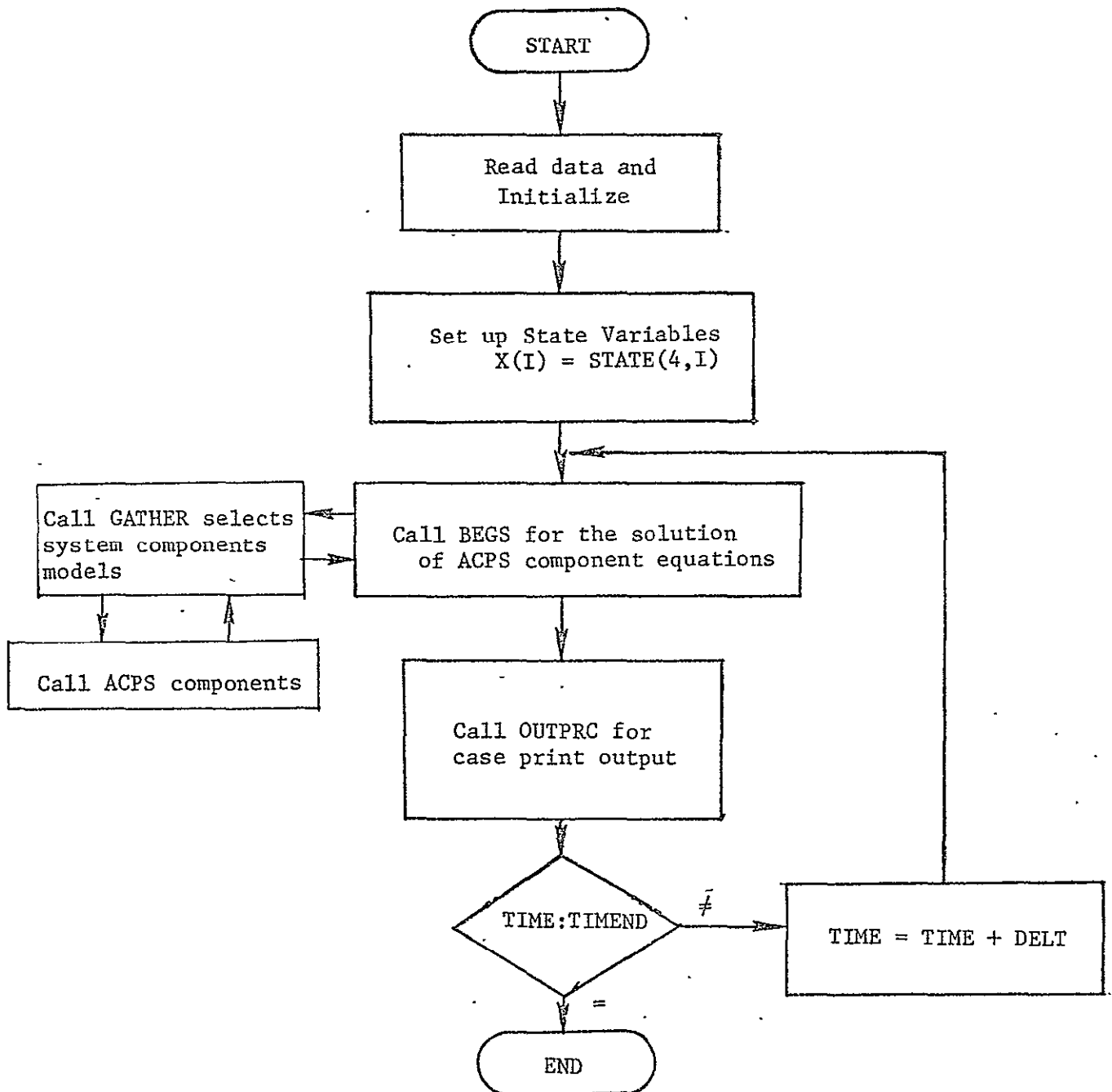


Figure 1. ACPS General Flowchart

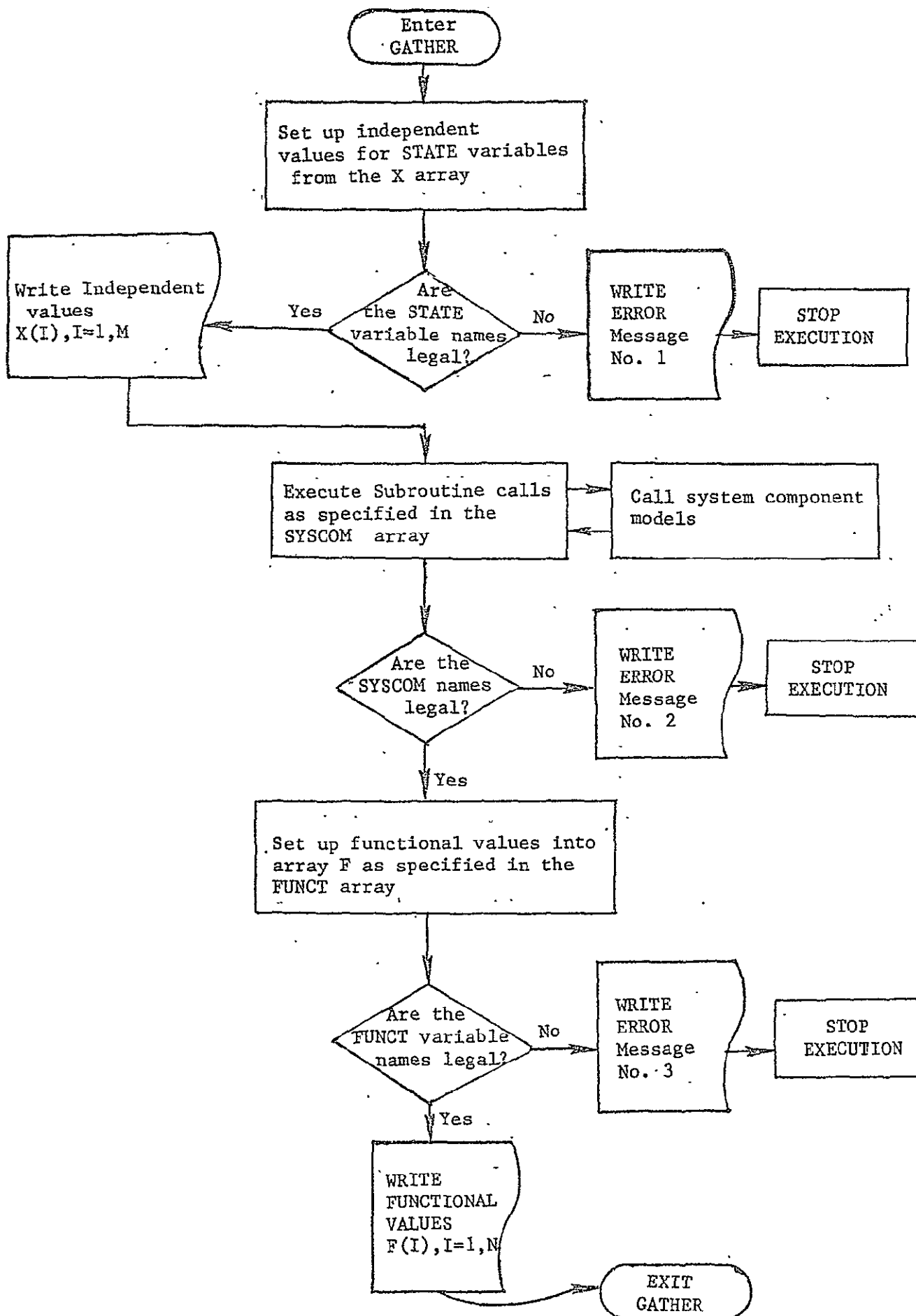


Figure 2. Flowchart for Subroutine GATHER

3. ATTITUDE CONTROL PROPULSION SYSTEM COMPUTER PROGRAM LISTING

This section contains a detailed listing of the steady-state attitude control propulsion system computer program including the element table, subroutine listings and program storage.

3.1 ELEMENT TABLE

TRACER	CODE	RELOCATABLE	15 JAN 68	17:12:25	1	02303300	24	1
QQPOS	VER2	RELOCATABLE	12 MAR 70	13:12:04	0	02303330	14	2
BCDINT		SYMBOLIC			1	02303364	24	1
BCDINT	CODE	RELOCATABLE	30 APR 71	11:18:48	0	02303414	14	8
BEGS		SYMBOLIC	30 APR 71	11:18:48	0	02303574	14	32
BEGS	CODE	RELOCATABLE			1	02304474	24	1
BINER	CODE	RELOCATABLE			0	02304524	14	9
BINSR	CODE	RELOCATABLE	30 APR 71	11:18:54	0	02304722	14	411
CWALL		SYMBOLIC	30 APR 71	11:18:54	1	02320114	24	1
CWALL	CODE	RELOCATABLE			0	02320144	14	123
DP2R		SYMBOLIC	30 APR 71	11:18:57	1	02323436	24	1
DP2R	CODE	RELOCATABLE			0	02323466	14	13
HPTTC	CODE	RELOCATABLE	30 APR 71	11:19:10	0	02323754	14	11
HPTV	CODE	RELOCATABLE	30 APR 71	11:19:10	1	02324206	24	1
HYDRO		SYMBOLIC			0	02324236	14	3
HYDRO	CODE	RELOCATABLE	30 APR 71	11:19:11	0	02324310	14	8
INTEG		SYMBOLIC	30 APR 71	11:19:11	1	02324470	24	1
INTEG	CODE	RELOCATABLE			0	02324520	14	2
INTERP		SYMBOLIC	30 APR 71	11:19:31	1	02324554	24	1
INTERP	CODE	RELOCATABLE			0	02324604	14	96
INTER2		SYMBOLIC	30 APR 71	11:19:34	1	02327304	24	1
INTER2	CODE	RELOCATABLE			0	02327334	14	100
LEGS		SYMBOLIC	30 APR 71	11:19:35	0	02332124	14	81
LEGS	CODE	RELOCATABLE	30 APR 71	11:19:35	1	02334302	24	1
OXYGEN		SYMBOLIC			0	02334332	14	29
OXYGEN	CODE	RELOCATABLE	30 APR 71	11:19:39	0	02335160	14	29
PACK		SYMBOLIC	30 APR 71	11:19:39	1	02336006	24	1
PACK	CODE	RELOCATABLE			0	02336036	14	7
PROPTY		SYMBOLIC	30 APR 71	11:19:40	0	02336200	14	35
PROPTY	CODE	RELOCATABLE	30 APR 71	11:19:40	1	02337152	24	1
PTHEAT	CODE	RELOCATABLE			0	02337202	14	20
R2DP		SYMBOLIC	30 APR 71	11:19:42	0	02337632	14	70
R2DP	CODE	RELOCATABLE	30 APR 71	11:19:42	1	02341556	24	1
SQZB		SYMBOLIC			0	02341606	14	30
SQZB	CODE	RELOCATABLE	30 APR 71	11:19:50	0	02342452	14	371
BLK2	CODE	RELOCATABLE	30 APR 71	11:19:50	1	02354564	24	1
					0	02354614	14	93
			30 APR 71	11:19:53	0	02357242	14	83
			30 APR 71	11:19:53	1	02361454	24	1
					0	02361504	14	36
			30 APR 71	11:19:55	0	02362474	14	61
			30 APR 71	11:19:55	1	02364222	24	1
					0	02364252	14	13
			30 APR 71	11:20:04	0	02364540	14	32
			30 APR 71	11:20:04	1	02365440	24	1
					0	02365470	14	15
			30 APR 71	11:20:06	1	02366012	24	1
					0	02366042	14	60
			30 APR 71	11:20:07	0	02367552	14	8
			30 APR 71	11:20:07	1	02367732	24	1
					0	02367762	14	2
			30 APR 71	11:20:08	0	02370016	14	31
			30 APR 71	11:20:08	1	02370700	24	1
					0	02370730	14	8
			19 MAY 71	02:49:41	1	02371110	24	1

HPTD	CODE	RELOCATABLE	19 MAY 71	02:50:07	0	02371140	14	119
					1	02374342	24	1
TEST	CODE	RELOCATABLE	19 MAY 71	02:50:27	0	02374372	14	141
					1	02400260	24	1
					0	02400310	14	4
BINSE		SYMBOLIC	01 MAR 71	18:47:30	0	02400400	14	101
BLK1		SYMBOLIC	01 MAR 71	18:49:05	0	02403206	14	166
BLK2		SYMBOLIC	01 MAR 71	18:49:07	0	02407632	14	183
HPTD		SYMBOLIC	10 MAY 71	12:52:01	0	02414634	14	275
HPTTC		SYMBOLIC	01 MAR 71	18:48:10	0	02424246	14	229
HPTV		SYMBOLIC	01 MAR 71	18:48:13	0	02432454	14	266
PTHEAT		SYMBOLIC	01 MAR 71	18:48:48	0	02441670	14	180
SAT		SYMBOLIC	14 JUN 71	15:04:53	0	02446620	14	24
SAT	CODE	RELOCATABLE	14 JUN 71	15:04:53	1	02447340	24	1
					0	02447370	14	13
LATENT		SYMBOLIC	14 JUN 71	15:04:54	0	02447656	14	30
LATENT	CODE	RELOCATABLE	14 JUN 71	15:04:54	1	02450522	24	1
					0	02450552	14	18
BPROPL		SYMBOLIC	14 JUN 71	15:04:55	0	02451146	14	36
BPROPL	CODE	RELOCATABLE	14 JUN 71	15:04:55	1	02452136	24	1
					0	02452166	14	25
BPROPG		SYMBOLIC	14 JUN 71	15:04:56	0	02452724	14	35
BPROPG	CODE	RELOCATABLE	14 JUN 71	15:04:56	1	02453676	24	1
					0	02453726	14	25
HPTCP		SYMBOLIC	14 JUN 71	15:04:57	0	02454464	14	39
HPTCP	CODE	RELOCATABLE	14 JUN 71	15:04:57	1	02455526	24	1
					0	02455556	14	3
HPTCV		SYMBOLIC	14 JUN 71	15:04:59	0	02455630	14	39
HPTCV	CODE	RELOCATABLE	14 JUN 71	15:04:59	1	02456672	24	1
					0	02456722	14	3
BETA		SYMBOLIC	14 JUN 71	15:05:17	0	02456774	14	16
BETA	CODE	RELOCATABLE	14 JUN 71	15:05:17	1	02457334	24	1
					0	02457364	14	12
WRITE		SYMBOLIC	14 JUN 71	15:05:19	0	02457634	14	86
WRITE	CODE	RELOCATABLE	14 JUN 71	15:05:19	1	02462120	24	1
					0	02462150	14	43
HEATEX		SYMBOLIC	14 JUN 71	15:05:32	0	02463302	14	358
HEATEX	CODE	RELOCATABLE	14 JUN 71	15:05:32	1	02475126	36	1
					0	02475172	14	132
TRNLOD		SYMBOLIC	14 JUN 71	15:05:35	0	02500662	14	348
TRNLOD	CODE	RELOCATABLE	14 JUN 71	15:05:35	1	02512272	36	1
					0	02512336	14	82
CDDATA		SYMBOLIC	14 JUN 71	15:05:38	0	02514532	14	432
CDDATA	CODE	RELOCATABLE	14 JUN 71	15:05:38	1	02530372	36	1
					0	02530436	14	109
NUSLET		SYMBOLIC	14 JUN 71	15:05:43	0	02533424	14	57
NUSLET	CODE	RELOCATABLE	14 JUN 71	15:05:43	1	02535062	24	1
					0	02535112	14	17
BDATA		SYMBOLIC	14 JUN 71	15:05:47	0	02535470	14	51
BDATA	CODE	RELOCATABLE	14 JUN 71	15:05:47	1	02537002	24	1
					0	02537032	14	4
H2OH2		SYMBOLIC	17 JUN 71	13:50:55	0	02537122	14	64
H2OH2	CODE	RELOCATABLE	17 JUN 71	13:50:55	1	02540722	24	1
					0	02540752	14	16
ADIAB		SYMBOLIC	23 JUN 71	21:25:16	0	02541312	14	100
ADIAB	CODE	RELOCATABLE	23 JUN 71	21:25:16	1	02544102	48	1
					0	02544162	14	35
CHOICE		SYMBOLIC	23 JUN 71	21:25:28	0	02545134	14	143
CHOICE	CODE	RELOCATABLE	23 JUN 71	21:25:28	1	02551056	24	1
					0	02551106	14	43

INITAL		SYMBOLIC
INITAL	CODE	RELOCATABLE
ISOTH		SYMBOLIC
ISOTH	CODE	RELOCATABLE
PERFOR		SYMBOLIC
PERFOR	CODE	RELOCATABLE
TANK		SYMBOLIC
TANK	CODE	RELOCATABLE
DRIVER		SYMBOLIC
DRIVER	CODE	RELOCATABLE
CMON		SYMBOLIC
CMON	CODE	RELOCATABLE
FEEDB		SYMBOLIC
FEEDB	CODE	RELOCATABLE
HEATX		SYMBOLIC
HEATX	CODE	RELOCATABLE
THERM		SYMBOLIC
THERM	CODE	RELOCATABLE
TPOCB1		SYMBOLIC
TPOCB1	CODE	RELOCATABLE
TPOCB2		SYMBOLIC
TPOCB2	CODE	RELOCATABLE
SSPIPE		SYMBOLIC
SSPIPE	CODE	RELOCATABLE
TRNDAT		SYMBOLIC
TRNDAT	CODE	RELOCATABLE
CHAM		SYMBOLIC
CHAM	CODE	RELOCATABLE
FCOMP1		SYMBOLIC
FCOMP1	CODE	RELOCATABLE
FCOMP2		SYMBOLIC
FCOMP2	CODE	RELOCATABLE
FCOMP3		SYMBOLIC
FCOMP3	CODE	RELOCATABLE
GATHER		SYMBOLIC
GATHER	CODE	RELOCATABLE
JUNCL		SYMBOLIC
JUNCL	CODE	RELOCATABLE

23 JUN 71	21:25:47	0	02552240	14	23
23 JUN 71	21:25:47	1	02552742	24	1
		0	02552772	14	8
23 JUN 71	21:25:51	0	02553152	14	95
23 JUN 71	21:25:51	1	02555634	48	1
		0	02555714	14	33
23 JUN 71	21:26:12	0	02556632	14	125
23 JUN 71	21:26:12	1	02562160	36	1
		0	02562224	14	54
23 JUN 71	21:26:25	0	02563610	14	60
23 JUN 71	21:26:25	1	02565500	36	1
		0	02565544	14	27
26 JUN 71	22:03:52	0	02566336	14	23
26 JUN 71	22:03:52	1	02567040	24	1
		0	02567070	14	17
30 JUN 71	20:46:25	0	02567446	14	147
30 JUN 71	20:46:25	1	02573460	36	1
		0	02573524	14	60
30 JUN 71	20:46:28	0	02575414	14	40
30 JUN 71	20:46:28	1	02576474	24	1
		0	02576524	14	7
30 JUN 71	20:46:39	0	02576666	14	136
30 JUN 71	20:46:39	1	02602446	36	1
		0	02602512	14	30
02 JUL 71	17:51:21	0	02603356	14	402
02 JUL 71	17:51:21	1	02616352	72	1
		0	02616462	14	81
02 JUL 71	17:51:35	0	02620640	14	1650
02 JUL 71	17:51:35	1	02676114	24	1
		0	02676144	14	747
02 JUL 71	17:51:39	0	02722476	14	386
02 JUL 71	17:51:39	1	02735132	24	1
		0	02735162	14	76
31 JUL 71	23:31:17	0	02737232	14	84
31 JUL 71	23:31:17	1	02741462	36	1
		0	02741526	14	22
31 JUL 71	23:32:00	0	02742212	14	101
31 JUL 71	23:32:00	1	02745020	24	1
		0	02745050	14	30
31 AUG 71	09:25:01	0	02745714	14	254
31 AUG 71	09:25:01	1	02754660	48	1
		0	02754740	14	100
31 AUG 71	09:25:02	0	02757530	14	42
31 AUG 71	09:25:02	1	02760644	24	1
		0	02760674	14	19
31 AUG 71	09:25:03	0	02761306	14	42
31 AUG 71	09:25:03	1	02762422	24	1
		0	02762452	14	14
31 AUG 71	09:25:05	0	02762756	14	37
31 AUG 71	09:25:05	1	02763764	24	1
		0	02764014	14	18
31 AUG 71	09:25:09	0	02764410	14	275
31 AUG 71	09:25:09	1	02774022	48	1
		0	02774102	14	04
31 AUG 71	09:25:10	0	02776332	14	107
31 AUG 71	09:25:10	1	03001264	36	1
		0	03001330	14	34

OUTPRC		SYMBOLIC	31 AUG 71 09:25:16	0	03002264	14	305
OUTPRC	CODE	RELOCATABLE	31 AUG 71 09:25:16	1	03012542	36	1
				0	03012606	14	166
PBL		SYMBOLIC	31 AUG 71 09:25:18	0	03017232	14	95
PBL	CODE	RELOCATABLE	31 AUG 71 09:25:18	1	03021714	36	1
				0	03021760	14	37
PIPL		SYMBOLIC	31 AUG 71 09:25:21	0	03022766	14	198
PIPL	CODE	RELOCATABLE	31 AUG 71 09:25:21	1	03030312	48	1
				0	03030372	14	73
PREG		SYMBOLIC	31 AUG 71 09:25:23	0	03032370	14	62
PREG	CODE	RELOCATABLE	31 AUG 71 09:25:23	1	03034134	36	1
				0	03034200	14	15
TANKD		SYMBOLIC	31 AUG 71 09:25:25	0	03034522	14	153
TANKD	CODE	RELOCATABLE	31 AUG 71 09:25:25	1	03040660	48	1
				0	03040740	14	37
VALVG		SYMBOLIC	31 AUG 71 09:25:27	0	03041746	14	91
VALVG	CODE	RELOCATABLE	31 AUG 71 09:25:27	1	03044340	36	1
				0	03044404	14	33
VALVL		SYMBOLIC	31 AUG 71 09:25:29	0	03045322	14	49
VALVL	CODE	RELOCATABLE	31 AUG 71 09:25:29	1	03046600	36	1
				0	03046644	14	11

ENTRY POINT TABLE

ADJAB (ADJAB/CODE)	1	000427	BCDINT (BCDINT/CODE)	1	000065	BEGS (BEGS/CODE)	1	002076
BETA (BETA/CODE)	1	000127	BINSER (BINSER/CODE)	1	000137	BPROPG (BPROPG/CODE)	1	000146
BPROPL (BPROPL/CODE)	1	000146	CDDATA (CDDATA/CODE)	1	001774	CHAM (CHAM/CODE)	1	001565
CHOICE (CHOICE/CODE)	1	000445	CMON (CMON/CODE)	1	001101	CHALL (CHALL/CODE)	1	000012

DP2R (DP2R/CODE)	1	000011	FCOMP1 (FCOMP1/CODE)	1	000214	FCOMP2 (FCOMP2/CODE)	1	000136
FCOMP3 (FCOMP3/CODE)	1	000177	FEEDB (FEEDB/CODE)	1	000054	GATHER (GATHER/CODE)	1	001251
HEATEX (HEATEX/CODE)	1	002212	HEATX (HEATX/CODE)	1	000404	HPTCP (HPTCP/CODE)	1	000016
HPTCV (HPTCV/CODE)	1	000016	HPTD (HPTD/CODE)	1	000544	HPTTC (HPTTC/CODE)	1	000504
HPTV (HPTV/CODE)	1	000461	HYDRO (HYDRO/CODE)	1	000102	H2OH2 (H2OH2/CODE)	1	000077
INITAL (INITAL/CODE)	1	000056	INTEG (INTEG/CODE)	1	000053	INTERP (INTERP/CODE)	1	000223
INTER2 (INTER2/CODE)	1	000365	ISOTH (ISOTH/CODE)	1	000403	JUNCL (JUNCL/CODE)	1	000404
KILLER (TRACER/CODE)	1	000000	LATENT (LATENT/CODE)	1	000056	LEGS (LEGS/CODE)	1	001521
NUSLET (NUSLET/CODE)	1	000130	OPDCP (THERM/CODE)	1	001227	OPDCV (THERM/CODE)	1	001151
OPDH (THERM/CODE)	1	001073	OPDIC (THERM/CODE)	1	001015	OPDIT (THERM/CODE)	1	000737
OPDT (THERM/CODE)	1	001305	OPTCP (THERM/CODE)	1	001253	OPTCV (THERM/CODE)	1	001175
OPTD (THERM/CODE)	1	000705	OPTH (THERM/CODE)	1	001117	OPTIC (THERM/CODE)	1	001041
OPTIT (THERM/CODE)	1	000763	OPTTC (THERM/CODE)	1	001363	OPTV (THERM/CODE)	1	001331
OUTPRC (OUTPRC/CODE)	1	002333	OXYGEN (OXYGEN/CODE)	1	000100	PACK (PACK/CODE)	1	000140
PBL (PBL/CODE)	1	000451	PERFOR (PERFOR/CODE)	1	000401	PIPL (PIPL/CODE)	1	001177
PIPLL (PIPL/CODE)	1	001204	PREG (PREG/CODE)	1	000153	PROPTY (PROPTY/CODE)	1	000136
PTHEAT (PTHEAT/CODE)	1	000617	QQFIL (QQPOS/VER2)	1	000002	QQREC (QQPOS/VER2)	1	000000
R2DP (R2DP/CODE)	1	000011	SAT (SAT/CODE)	1	000040	SQZB (SQZB/CODE)	1	000063
TANK (TANK/CODE)	1	000271	TANKC (TANKD/CODE)	1	000507	TANKD (TANKD/CODE)	1	000502
TEST (TEST/CODE)	1	000006	TRACER (TRACER/CODE)	1	000003	TRWLOD (TRWLOD/CODE)	1	001216
TURBOP (CHAM/CODE)	1	001572	VALVG (VALVG/CODE)	1	000405	VALVL (VALVL/CODE)	1	000114
WRITE (WRITE/CODE)	1	000527						

SPHEAT (BLK2/CODE) 34 BANK 2 DEPENDENT
CPNS {BDATA/CODE}, 34 BANK 2 DEPENDENT
PCB {PCB2/CODE}

INDATA (BDATA/CODE) 34 BANK 2 DEPENDENT
PCB {PCB1/CODE} 34 BANK 2 DEPENDENT
STAB {TRNDAT/CODE}

COBOL LIBRARY TABLE EMPTY

PROCEDURE NAME TABLE EMPTY

END CUR LCC 1102-0038 L8
B HDG B FOR, SSPIPE,SSPIPE

3.2.1 SSIPE (PROGRAM DRIVER)

31 AUG 71

9:26:16.251

UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:26:16

MAIN PROGRAM

STORAGE USED (BLOCK, NAME, LENGTH)

```
0001 *CODE 000233
0000 *DATA 011367
0002 *BLANK 000000
0003 INDATA 011610
0004 CONS 000003
0005 COM 006525
```

EXTERNAL REFERENCES (BLOCK, NAME)

```
0006 GATHER
0007 TRWLOD
0010 ALOG
0011 BEGS
0012 OUTPRC
0013 NSTOPS
0014 NWDUS
0015 NIOZS
0016 NIOIS
```

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000000 10L	0001 000020 115G	0001 000107 136G	0001 000156 151G	0001 000170 160G
0000 011312 30F	0001 000102 40L	0001 000113 51L	0000 011324 60F	0000 011335 70F
0000 011345 80F	0010 R 000000 ALOG	0005 R 000000 AREA	0005 R 000074 AREA1	0005 R 000170 AREAK
0005 R 000132 AREAO	0000 R 000074 BLOCK	0003 R 000766 BOUNDS	0005 R 005060 CF	0005 R 006423 CGGTC
0005 R 006436 CGTANK	0005 R 006431 CLTANK	0005 R 005014 CONCT	0005 R 006443 CPJU	0005 R 005006 CSTAR
0005 R 006355 CVEL	0003 R 000077 DELT	0005 R 000036 DELXL	0005 R 000226 DIALI	0003 R 000510 DIALO
0005 R 006277 DMVENT	0003 R 000765 EPSLN	0005 R 006360 ETAT	0000 R 000000 F	0004 R 000002 FB
0005 R 006370 FBPC	0005 R 006376 FBTC	0005 R 006362 FBWC	0000 R 011307 FNORM	0005 R 005111 FRL
0004 R 000001 GC	0003 R 000613 H	0005 R 003132 HI	0005 R 003036 HO	0005 R 003322 HRAD
0000 I 011305 I	0000 I 011311 IBLEW	0003 I 000675 IBNDS	0005 I 005110 ICMON	0003 I 000701 IDER
0003 I 000702 IFIN	0005 I 005052 ISPT	0000 I 011306 ITERS	0005 I 003606 JUN	0003 I 000703 JVECTR
0000 I 011304 K	0003 I 000676 M	0003 I 000700 MAXIT	0005 I 005066 MEX	0005 I 004756 MR
0005 I 005102 MWC	0003 I 000677 N	0005 I 002552 NGR	0003 I 000100 NODEL	0003 I 005713 NPIPL
0005 I 002646 NPR	0005 I 002742 NRE	0000 R 011310 P	0005 R 000264 PB	0005 R 004764 PC
0005 R 004772 PCN	0005 R 005074 PE	0005 R 000272 PG	0005 R 003620 PGT	0004 R 000000 PI
0005 R 005036 PMR	0005 R 006241 POWC	0005 R 006350 POWP	0005 R 006343 POWT	0005 R 006300 PPI
0005 R 006305 PPO	0005 R 006331 PTI	0005 R 006336 PTO	0005 R 006357 R	0003 R 005754 RFLAG
0005 R 001422 RHUG	0005 R 006312 RPMT	0003 R 000000 S	0003 R 007541 STATE	0005 R 005044 TC
0003 R 000451 TH	0005 R 006416 THOC	0003 R 000611 TIME	0003 R 000612 TIMEND	0005 R 006411 TPCG
0005 R 006404 TPCL	0005 R 006317 TTI	0005 R 006324 TIO	0005 R 003226 TWALL	0005 R 006356 U
0005 R 003416 UAO	0005 R 003512 VEL	0005 R 006265 WI	0005 R 004750 WNOZ	0005 R 006253 WO
0005 R 006361 WT	0005 R 006246 WTGC	0000 R 000036 X	0003 R 000413 XLEN	

```

00100 1. C
00101 2. EXTERNAL G
00101 3. C
00103 4. DIMENSION H(20),DIALO(30),XLENG(30),NODEL(20),TH(30)
00103 5. , JVECTR(20),STATE(4,40),BOUNDS(20)
00103 6. C
00104 7. DIMENSION F(30),X(30),BLOCK(4744)
00104 8. C
00105 9. COMMON /INDATA/S(5000)
00105 10. C
00106 11. COMMON /CONS/PI,GC,FB
00106 12. C
00107 13. COMMON /COM/AREA(30),DELXL(30),AREA1(30),AREA0(30),AREAK(30)
00107 14. *, DIALI(30),PB(6),PG(30,20),RHOG(30,20),NGR(30,2)
00107 15. *, NPR(30,2),NRE(30,2),HO(30,2),HI(30,2),TWALL(30,2)
00107 16. *, HRAD(30,2),UAO(30,2),VEL(30,2),JUN(10),PGT(30,20)
00107 17. *, WNOZ(6),MR(6),PC(6),PCN(6,2),CSTAR(6),CONCT(3,6)
00107 18. *, PMR(6),TC(6),ISPT(6),CF(6),MEX(6),PE(6),MWC(6),ICMON
00107 19. *, FRL(30,20),POWC(5),WTGC(5),WO(10),WI(10),DMVENT,PPI(5)
00107 20. *, PPO(5),RPM(5),TTI(5),TTO(5),PTI(5),PTO(5),POWT(5)
00107 21. *, POWP(5),CVEL,U,R,ETAT,WT,FBWC(6),FBPC(6)
00107 22. *, FBTC(6),TPCL(5),TPCG(5),THOC(5),CGGTC(6),CLTANK(5)
00107 23. *, CGTANK(5),CPJU(5,10)
00107 24. C
00110 25. EQUIVALENCE
00110 26. *, (S(268),XLENG(1)), (S(298),TH(1)), (S(329),DIALO(1))
00110 27. *, (S(65),NODEL(1)), (S(3020),NPIPL), (S(396),H(1))
00110 28. *, (S(446),BOUNDS), (S(447),M), (S(448),N)
00110 29. *, (S(449),MAXIT), (S(450),IDER), (S(451),IFIN)
00110 30. *, (S(452),JVECTR(1)), (S(502),EPSLN), (S(503),BOUNDS(1))
00110 31. *, (S(3938),STATE(1,1))
00110 32. *, (S(64),DELT), (S(394),TIME), (S(395),TIMEND)
00110 33. *, (S(3053),RFLAG)
00110 34. C
00110 35. C
00110 36. C
00111 37. 10 CALL TRWLOD(5,6,K)
00112 38. IF (K.EQ.2) STOP
00112 39. C
00114 40. DO 20 I=1,NPIPL
00117 41. AREA(I) = 0.25*PI*DIALO(I)**2
00120 42. DELXL(I) = XLENG(I)/(NODEL(I)-1)
00121 43. DIALI(I) = DIALO(I) - 2.0*TH(I)
00122 44. AREA1(I) = PI*DIALI(I)*DELXL(I)/12.0
00123 45. AREA0(I) = PI*DIALO(I)*DELXL(I)/12.0
00124 46. AREAK(I) = ALOG(DIALO(I)/DIALI(I))/(2.*PI*DELXL(I))
00125 47. 20 CONTINUE
00125 48. C
00125 49. C SOLUTION OF NON LINEAR EQUATIONS
00125 50. C
00127 51. IF (M.LE.30) GO TO 40
00131 52. WRITE(6,30)
00133 53. 30 FORMAT(4X52H*** MORE THAN 30 VARIABLES SPECIFIED - ABORT RUN *** )
00134 54. STOP
00135 55. 40 DO 50 I=1,M
00140 56. X(I) = STATE(4,I)

```

FOR,* SSPIPE,SSPIPE

DATE 310871 PAGE 74

```

00141 57* 50 CONTINUE
00141 58* C
00143 59* ICMON = 0
00144 60* 51 CONTINUE
00144 61* C
00145 62* CALL BEGS (X,H,IBNDS,BOUNDS,M,N,MAXIT,IDER,IFIN,JVECTR,EPSLN,
00145 63* BLOCK,GATHER,ITERS,F,FNORM)
00145 64* C
00146 65* CALL GATHER (X,F,P,IBLEW)
00146 66* C
00147 67* WRITE (6,60)(X(I),I=1,M)
00155 68* 60 FORMAT(1H1//18X28HSSPIPE-INDEPENDENT VARIABLES/(7X1P6E17.7))
00156 69* WRITE (6,70)(F(I),I=1,N)
00164 70* 70 FORMAT(//19X22HSSPIPE-FUNCTION VALUES/(7X1P6E17.7))
00165 71* WRITE (6,80)ITERS,FNORM
00171 72* 80 FORMAT(//27X 6HSSPIPE/7X117.1P5E17.7)
00171 73* C
00172 74* CALL OUTPRC
00172 75* C
00173 76* IF (DELT .LE. 0.) DELT = 1.
00173 77* C PARTIAL MATRIX FIRST TIME ONLY
00175 78* IDER = 1
00176 79* RFLAG = 1.
00177 80* TIME = TIME + DELT
00200 81* IF (TIME .LE. TIMEND) GO TO 51
00202 82* GO TO 10
00202 83* C
00203 84* END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

SSPIPE	CODE	SYMBOLIC	RELOCATABLE	31 JUL 71	23:31:17	0	02737232	14	84. (DELETED)
SSPIPE	CODE	SYMBOLIC	RELOCATABLE	31 JUL 71	23:31:17	1	02741462	36	1 (DELETED)
SSPIPE	CODE	SYMBOLIC	RELOCATABLE	31 JUL 71	23:31:17	0	02741526	14	22

5 HDG 5 FOR,* ADIAB,ADIAB

UNIVAC 1108 FORTRAN V LEVEL 2200018 F5018H
THIS COMPILATION WAS DONE ON 31 71 AT 09:26:29

SUBROUTINE ADIAB ENTRY POINT 000427

STORAGE USED (BLOCK, NAME, LENGTH)

```
0001  *CODE  000441
0000  *DATA  000065
0002  *BLANK 000000
0003  INDATA 011610
0004  CONS   000003
0005  COM     006525
```

EXTERNAL REFERENCES (BLOCK, NAME)

```
0006  OPTCP
0007  OPTCV
0010  OPTV
0011  HPTCP
0012  HPTCV
0013  HPTV
0014  FCOMP3
0015  NERR2$
0016  SQR1
0017  NEXP6$
0020  NWDU$
0021  NIO1$
0022  NIO2$
0023  NERR3$
```

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000021 IL	0000 000014 IOF	0001 000043 2L	0001 000412 2OL	0001 000064 5L
0000 R 000011 ADIA	0005 R 000000 AREA	0005 R 000074 AREA1	0005 R 000170 AREAK	0005 R 000132 AREAO
0005 R 005060 CF	0005 R 006423 CGGTC	0005 R 006436 CGTANK	0005 R 006431 CLTANK	0005 R 005014 CONCT
0003 R 005714 CP	0005 R 006443 CPJU	0005 R 005006 CSTAR	0000 R 000010 CV	0005 R 006355 CVEL
0005 R 000036 DELXL	0005 R 000226 DIALI	0005 R 006277 DMVENT	0005 R 006360 ETAT	0004 R 000002 FB
0005 R 006370 FBPC	0005 R 006376 FBTC	0005 R 006362 FBWC	0005 R 005111 FRL	0004 R 000001 GC
0005 R 003132 HI	0005 R 003036 HO	0011 R 000000 HPTCP	0012 R 000000 HPTCV	0013 R 000000 HPTV
0005 R 003322 HRAD	0005 I 005110 ICMON	0003 I 000551 IPROP	0005 I 005052 ISPT	0000 I 000005 JJ
0005 I 003606 JUN	0003 R 003413 KA	0003 R 004561 MACH	0005 I 005066 MEX	0005 I 004756 MR
0005 I 005102 MWC	0005 I 002552 NGR	0003 I 000553 NPLINE	0005 I 002646 NPR	0005 R 002742 NRE
0006 R 000000 OPTCP	0007 R 000000 OPTCV	0010 R 000000 OPTV	0000 R 000006 P	0005 R 000264 PB
0005 R 004764 PC	0005 R 004772 PCN	0005 R 005074 PE	0005 R 000272 PG	0005 R 003620 PGT
0004 R 000000 PI	0005 R 005036 PMR	0005 R 006241 POWC	0005 R 006350 POWP	0005 R 006343 POWT
0005 R 006300 PP1	0005 R 006305 PPO	0005 R 006331 PT1	0005 R 006336 PTO	0005 R 006357 R
0003 R 005754 RFLAG	0003 R 005711 RGAS	0005 R 001422 RHOG	0005 R 006312 RPMT	0003 R 000000 S
0000 R 000007 T	0005 R 005044 TC	0005 R 006416 THOC	0005 R 006411 TPCG	0005 R 006404 TPCL
0003 R 001132 TTEMP	0005 R 006317 TT1	0005 R 006324 TIO	0003 R 002262 TTEMP	0005 R 003226 TWALL
0005 R 006356 U	0005 R 003416 UAO	0005 R 003512 VEL	0003 R 000253 VISC	0000 R 000000 W
0003 R 003423 WDOTG	0005 R 006265 W1	0005 R 004750 WNOZ	0005 R 006253 W0	0005 R 006361 WT

0005 R 006246 WTGC

0000 R 000012 X

0003 R 000413 XLENGL

0000 R 000013 Y

```

00100 10 C
00100 20 C ADIABATIC LINE SUBROUTINE
00100 30 C
00101 40 SUBROUTINE ADIAB (II)
00101 50 C
00103 60 REAL KA, MACH, NRE
00103 70 C
00104 80 DIMENSION W(5)
00105 90 DIMENSION VISC(30), XLENGL(30), NPLINE(30), KA(2), RGAS(2)
00105 100 , MACH(30,20), TTEMP(30,20), TTTEMP(30,20), CP(30)
00105 110 , WDOTG(30,20)
00105 120 C
00106 130 COMMON /INDATA/S(5000)
00106 140 C
00107 150 COMMON /CONS/PI, GC, FB
00107 160 C
00110 170 COMMON /COM/AREA(30), DELXL(30), AREA1(30), AREA0(30), AREAK(30)
00110 180 , DIALI(30), PB(6), PG(30,20), RHOG(30,20), NGR(30,2)
00110 190 , NPR(30,2), NRE(30,2), HO(30,2), HI(30,2), TWALL(30,2)
00110 200 , HRAD(30,2), UAO(30,2), VEL(30,2), JUN(10), PGT(30,20)
00110 210 , WNOZ(6), MR(6), PC(6), PCN(6,2), CSTAR(6), CONCT(3,6)
00110 220 , PMR(6), TC(6), ISPT(6), CF(6), MEX(6), PE(6), MAC(6), ICMON
00110 230 , FRL(30,20), POWC(5), WTGC(5), HO(10), WI(10), DMVENT, PPI(5)
00110 240 , PPO(5), RPMT(5), TTI(5), TTO(5), PTI(5), PTO(5), POWT(5)
00110 250 , POWP(5), CVEL, U, R, ETAT, WT, FBWC(6), FBPC(6)
00110 260 , FBTC(6), TPCLI(5), TPCG(5), THOC(5), CGGTC(6), CLTANK(5)
00110 270 , CGTANK(5), CPJU(5,10)
00110 280 C
00111 290 EQUIVALENCE
00111 300 , (S(172), VISC(1)) , (S(268), XLENGL(1)) , (S(3018), RGAS(1))
00111 310 , (S(362), IPROP) , (S(364), NPLINE(1)) , (S(1804), KA(1))
00111 320 , (S(2418), MACH(1,1)) , (S(603), TTEMP(1,1)) , (S(1203), TTTEMP(1,1))
00111 330 , (S(3021), CP(1)) , (S(1812), WDOTG(1,1))
00111 340 , (S(3053), RFLAG)
00111 350 C
00112 360 JJ = 1
00112 370 C
00113 380 IPROP = NPLINE(11)
00114 390 P = PG(11,1)
00115 400 T = TTEMP(11,1)
00116 410 GO TO (1,2), IPROP
00116 420 C OXYGEN
00117 430 1 CP(11) = OPTCP(P,T)
00120 440 CV = OPTCV(P,T)
00121 450 VISC(11) = OPTV(P,T) * 32.2 * 3600.
00122 460 GO TO 5
00122 470 C
00122 480 C HYDROGEN
00123 490 2 CP(11) = HPTCP(P,T)
00124 500 CV = HPTCV(P,T)
00125 510 VISC(11) = HPTV(P,T) * 32.2 * 3600.
00126 520 5 CONTINUE
00127 530 RGAS(IPROP) = (CP(11) - CV) * 778.156

```

```

00130 54 KA(IPROP) = 1.0 / CV
00131 55 VEL(II,JJ) = MACH(II,JJ)*SQRT(KA(IPROP)*GC*RGAS(IPROP)*TTEMP(II,JJ)
00131 56 1)
00132 57 TTEMP(II,JJ) = TTEMP(II,JJ)+VEL(II,JJ)**2/(2*GC*FB*CP(II))
00132 58 C DENSITY OF GAS
00133 59 RHOG(II,JJ) = PG(II,JJ)/(RGAS(IPROP)*TTEMP(II,JJ))*144.0
00133 60 C REYNOLDS NUMBER
00134 61 NRE(II,JJ) = VEL(II,JJ)*DIALI(II)*RHOG(II,JJ)/(VISC(II)*12.0)
00134 62 C KOO FRICTION FACTOR FOR SMOOTH PIPES - PG.383 CHE. HANDBOOK EQ. 24
00135 63 FRL(II,JJ) = 1.4E-3 + 1.25E-1*(NRE(II,JJ))**(-0.32)
00135 64 C
00136 65 W(1) = MACH(II,1)
00137 66 W(2) = FRL(II,1)
00140 67 W(3) = XLENG(II)
00141 68 W(4) = DIALI(II)
00142 69 W(5) = KA(IPROP)
00142 70 C
00143 71 CALL FCOMP3 (W,MACH(II,2),ADIA)
00143 72 C
00143 73 C ADIABATIC FLOW CONTANT AREA DUCT INTEGRAL RELATIONSHIPS
00144 74 X = 1.0 + (KA(IPROP)-1.0)*0.5*MACH(II,JJ)**2
00145 75 Y = 1.0 + (KA(IPROP)-1.0)*0.5*MACH(II,JJ+1)**2
00145 76 C STATIC TEMP
00146 77 TTEMP(II,JJ+1) = TTEMP(II,JJ)*X/Y
00146 78 C TOTAL TEMP
00147 79 TTTEMP(II,2) = TTTEMP(II,1)
00147 80 C STATIC PRESS
00150 81 PG(II,2) = PG(II,1)*MACH(II,1)/MACH(II,2)*SQRT(X/Y)
00150 82 C TOTAL PRESS
00151 83 PGT(II,JJ) = PG(II,JJ)*X**((KA(IPROP)/(KA(IPROP)-1.0))
00152 84 PGT(II,2) = PG(II,2)*Y**((KA(IPROP)/(KA(IPROP)-1.0))
00152 85 C DENSITY
00153 86 RHOG(II,JJ+1) = PG(II,JJ+1)/(RGAS(IPROP)*TTEMP(II,JJ+1))
00153 87 C
00153 88 C FLOWRATE
00154 89 WDOTG(II,2) = WDOTG(II,1)
00154 90 C
00155 91 IF (RFLAG).20,
00160 92 WRITE (6,10) II,JJ,II,JJ,IPROP,NPLINE(II),IPROP,IPROP,VEL(II,JJ),MA
00160 93 2CH(II,JJ),KA(IPROP),GC,RGAS(IPROP),TTEMP(II,JJ),TTTEMP(II,JJ),VISC
00160 94 3(II),CP(II),RHOG(II,JJ),NRE(II,JJ),DIALI(II),XLENG(II),FB,X,Y,PG(
00160 95 4(II,JJ),PG(II,JJ+1),PGT(II,JJ),PGT(II,JJ+1),RHOG(II,JJ+1),TTEMP(II,
00160 96 5JJ+1),TTTEMP(II,JJ+1),W(1),WDOTG(II,1),WDOTG(II,2)
00224 97 10 FORMAT(1H1//24X13HAD)AB=ROUTINE/7X4117/7X4117/(7X1P4E17.7))
00224 98 C
00225 99 20 RETURN
00226 100 END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

AD1AB	SYMBOLIC	23 JUN 71	21:25:16	0	01674702	14	100	(DELETED)
AD1AB	CODE	RELOCATABLE	23 JUN 71	21:25:16	1	01677472	48	1 (DELETED)
					0	01677552	14	35

FOR, BCDINT,BCDINT

3.2.3 BCDINT

@ FOR, BCDINT,BCDINT
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:26:32

31 AUG 71

9:26:31.870

SUBROUTINE BCDINT ENTRY POINT 000065

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000110
 0000 *DATA 000033
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 SQZ8
 0004 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000017	113G	0001	000022	116G	0001	000037	3L	0001	000042	5L	0001	000046	900L
0001	000050	999L	0000	000012	15	0000	000014	J	0000	000013	K	0000	000000	NUM

61

```

00101 1*      SUBROUTINE BCDINT(NCOL, INT, N)
00101 2*      C.....
00101 3*      C.....CONVERTS A BCD NUMBER TO A BINARY INTEGER AND RETURNS THE VALUE
00101 4*      C.....THROUGH THE ARGUMENT (INT).
00101 5*      C.....N IS THE NUMBER OF WORDS INPUT AND THE NUMBER OF NON-BLANK
00101 6*      C.....CHARACTERS OUTPUT. N IS NEGATIVE FOR AN ERROR WITH THE MAGNITUDE
00101 7*      C.....BEING THE SUBSCRIPT OF THE INCORRECT WORD.
00101 8*      C.....
00103 9*      DIMENSION
00103 10*     * NCOL(1) ,NUM(10)
00103 11*     C.....
00104 12*     DATA
00104 13*     * NUM / 1H0, 1H1, 1H2, 1H3, 1H4, 1H5, 1H6, 1H7, 1H8, 1H9 /
00104 14*     C.....
00106 15*     INT=0
00106 16*     C.....GET RID OF THE BLANKS
00107 17*     CALL SQZ8(NCOL(1), N)
00110 18*     IF(N.EQ.0) GO TO 999
00112 19*     DO 5 K=1,N
00115 20*     DO 3 J=1,10
00120 21*     IF(NCOL(K).NE.NUM(J)) GO TO 3
00122 22*     INT = INT*10 + 1ABS(J-1)
00123 23*     GO TO 5
00123 24*     C.....
00124 25*     3 CONTINUE
00126 26*     GO TO 900
00126 27*     C.....
00127 28*     5 CONTINUE
  
```

00131 29* GO TO 999
 00132 30* 900 N = -K
 00133 31* 999 RETURN
 00134 32* END

END OF UNIVAC 1108 FORTRAN V COMPILATION.

BCDINT SYMBOLIC
 BCDINT CODE RELOCATABLE

D *DIAGNOSTIC* MESSAGE(S)

30 APR 71	11:18:48	0	01437164	14	32	(DELETED)
30 APR 71	11:18:48	1	01440064	24	1	(DELETED)
		0	01440114	14	9	

S HOG FOR,* BDATA,BDATA

3.2.4 BDATA

FOR.* BDATA,BDATA
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:26:33

31 AUG 71

9:26:32.919

BLOCK DATA

STORAGE USED (BLOCK, NAME, LENGTH)

0003 INDATA 011610
 0004 CONS 000003

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0003 R 006466 CP2	0003 R 006203 CS2	0004 R 000002 FB	0004 R 000001 GC	0000 I 000000 I
0003 R 006207 IS2	0003 R 006173 MW2	0004 R 000000 PI	0003 R 000741 POW0	0003 R 000746 POW1
0003 R 000753 POW2	0003 R 006663 POW3	0003 R 000651 PNO	0003 R 000656 PW1	0003 R 000663 PW2
0003 R 000000 S	0003 R 006177 TC2			

21

00101	1°	BLOCK DATA
00101	2°	C
00102	3°	REAL MW2,IS2
00102	4°	C
00103	5°	DIMENSION MW2(4),TC2(4),CS2(4),IS2(4),CP2(5),PNO(5),PW1(5),PW2(5)
00103	6°	*, POW0(5),POW1(5),POW2(5),POW3(5)
00103	7°	C
00104	8°	COMMON /INDATA/S(5000)
00104	9°	C
00105	10°	COMMON /CONS/PI,GC,FB
00105	11°	C
00106	12°	EQUIVALENCE
00106	13°	*,(S(3196),MW2(1)),(S(3200),TC2(1)),(S(3204),CS2(1))
00106	14°	*,(S(3208),IS2(1)),(S(3383),CP2(1)),(S(426),PNO(1))
00106	15°	*,(S(431),PW1(1)),(S(436),PW2(1)),(S(482),POW0(1))
00106	16°	*,(S(487),POW1(1)),(S(492),POW2(1)),(S(3508),POW3(1))
00106	17°	C
00107	18°	DATA
00107	19°	*, PI / 3.1415927 /, GC / 32.174049 /
00107	20°	*, FB / 777.9 /
00107	21°	C
00113	22°	DATA (MW2(1),I=1,4) /
00113	23°	1 0.19109966E1, 0.21066749E1, -0.44042913E-2, -0.60646600E-2 /
00113	24°	C
00115	25°	DATA (TC2(1),I=1,4) /
00115	26°	1 0.44354884E3, 0.21022635E4, -0.24057595E3, 0.81889125E1 /
00115	27°	C
00117	28°	DATA (CS2(1),I=1,4) /
00117	29°	1 0.70174506E4, 0.11752099E4, -0.30091700E3, 0.20546873E2 /
00117	30°	C
00121	31°	DATA (IS2(1),I=1,4) /
00121	32°	1 0.34833907E3, 0.75678814E2, -0.17121626E2, 0.11873112E1 /
00121	33°	C
00123	34°	DATA (CP2(1),I=1,4) /

```

00123 35* 1 0.25917475 0.74177182E0,0.12549806E0,-0.82476042E-2 /
00123 36* C
00125 37* DATA POW(1)/ 0.12503708E4/
00125 38* C
00127 39* DATA POW(1)/ 0.24354174E2/
00127 40* C
00131 41* DATA POW(1)/-0.50557429E1/
00131 42* C
00133 43* DATA POW(1)/0.29375007E6/
00133 44* C
00135 45* DATA POW(1)/0.21971513E5/
00135 46* C
00137 47* DATA POW(1)/0.50103014E3/
00137 48* C
00141 49* DATA POW(1)/0.78168831E1/
00141 50* C
00143 51* END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

D *DIAGNOSTIC* MESSAGE(S)

BDATA CODE SYMBOLIC
BDATA RELOCATABLE

14 JUN 71	15:05:47	0	01671060	14	51 (DELETED)
14 JUN 71	15:05:47	1	01672372	24	1 (DELETED)
		0	01672422	14	4

0 HDG 6 FOR, BEGS,BEGS

3.2.5 BEGS

FOR, BEGS, BEGS
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:26:33

31 AUG 71

9:26:33.766

SUBROUTINE BEGS ENTRY POINT 002076

STORAGE USED (BLOCK, NAME, LENGTH)

```
0001 *CODE 002204
0000 *DATA 000224
0002 *BLANK 000000
```

EXTERNAL REFERENCES (BLOCK, NAME)

```
0003 LEGS
0004 NWDUS
0005 NIOIS
0006 NIOZS
0007 NERR3S
```

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000105 100L	0001 001674 1000G	0001 001730 1013G	0001 002024 1020L	0001 001743 1021G
0001 002033 1030L	0001 001766 1034G	0001 002040 1040L	0001 002002 1042G	0001 000111 110L
0001 000051 132G	0001 000122 140L	0001 000070 146G	0001 000124 150L	0001 000023 20L
0001 000213 200L	0001 000177 210G	0001 000230 223G	0001 000251 230L	0001 000253 240L
0001 000270 245L	0001 000304 255G	0001 000314 280L	0001 000320 290L	0001 000341 310L
0001 000403 313G	0001 000440 333G	0001 000357 340L	0001 000471 350G	0001 000372 360L
0001 000523 363G	0001 000526 366G	0001 000416 380L	0001 000554 402G	0001 000466 410L
0001 000650 417G	0001 000661 424G	0001 000503 430L	0001 000766 440G	0001 000510 440L
0001 000547 460L	0001 001024 461G	0001 001054 471G	0001 000601 490L	0001 001077 502G
0001 000713 510L	0001 001116 514G	0001 000755 520L	0001 001140 524G	0001 001010 540L
0001 001166 543G	0001 001240 566G	0001 001036 570L	0001 001252 577G	0001 001062 590L
0001 001067 600L	0001 001277 607G	0001 001110 620L	0001 001331 623G	0001 001332 626G
0001 001356 637G	0001 001127 640L	0001 001131 650L	0001 001406 654G	0001 001435 670G
0001 001143 670L	0001 001150 680L	0001 001160 700L	0001 001477 712G	0001 001212 720L
0001 001543 730G	0001 001217 730L	0001 001556 736G	0001 001632 755G	0001 001656 772G
0001 001350 820L	0001 001371 840L	0001 001375 847L	0001 001426 860L	0001 001471 880L
0000 000104 8995F	0001 001512 900L	0000 000127 9000F	0000 000052 9005F	0000 000057 9010F
0000 000064 9015F	0000 000071 9020F	0000 000076 9025F	0001 001576 930L	0001 001605 940L
0001 001643 970L	0000 R 000025 A1	0000 R 000006 BF	0000 R 000010 BST	0000 R 000002 EPSL
0000 I 000007 I	0000 I 000005 IBLEW	0000 I 000003 IDER	0000 I 000047 IFS	0000 I 000004 IP
0000 I 000035 IPF	0000 I 000050 IPR	0000 I 000034 IQ	0000 I 000040 IRV	0000 I 000037 IRX
0000 I 000046 IN	0000 I 000033 IX	0000 I 000045 IY	0000 I 000044 IZ	0000 I 000027 J
0000 I 000021 JAR	0000 I 000020 JATA	0000 I 000015 JAZ	0000 I 000024 JD	0000 I 000011 JJ
0000 I 000032 JK	0000 I 000036 JON	0000 I 000012 JPFF	0000 I 000013 JPY	0000 I 000017 JQ
0000 I 000022 JV	0000 I 000016 JW	0000 I 000014 JY	0000 I 000030 JZ	0000 I 000023 K
0000 I 000031 KI	0000 I 000000 M	0000 I 000001 N	0000 R 000026 P	0000 R 000051 SF
0000 R 000043 SUP	0000 R 000042 SUS	0000 R 000041 T		


```

00100 1* C TRN BEGS=SOLUTION A SYSTEM OF NON-LINEAR EQUATIONS
00101 2* SUBROUTINE BEGS(X,H,IBNDS,BNDS,MX,NY,
00101 3* 1 MAXIT,IDEV,IFIN,IV,EPS,S,FCALC,NIT,F,BSST)
00101 4* C MODIFIED FEB 1968
00103 5* DIMENSION S(1),X(1),H(1),BNDS(1),IV(1),F(1)
00103 6* C
00104 7* AB(P)=ABS(P)
00105 8* 9005 FORMAT(20H ***SUM OF F(1)**2=E16.7)
00106 9* 9010 FORMAT(7H0 X=7E16.7/(7X,7E16.7))
00107 10* 9015 FORMAT(7H F=7E16.7/(7X,7E16.7))
00110 11* 9020 FORMAT(20H SUM OF F(1)**2=E16.7)
00111 12* 9025 FORMAT ( 4H0 X(12,15H) PERTURBED BY E11.4)
00111 13* C TO CONVERT TO DOUBLE PRECISION, REMOVE THE
00111 14* C ABOVE 4 CARDS AND REMOVE THE C FROM
00111 15* C COLUMN 1 OF THE FOLLOWING 8 CARDS
00111 16* C DOUBLE PRECISION X,H,BNDS,S,F,BSST,BST,BF,
00111 17* C 1 P,SF,A1,T,SUS,SUP
00111 18* C AB(P)=DABS(P)
00111 19* C9005 FORMAT(20H ***SUM OF F(1)**2=D27.16)
00111 20* C9010 FORMAT(7H0 X=3D27.16/(7X,3D27.16))
00111 21* C9015 FORMAT(7H F=3D27.16/(7X,3D27.16))
00111 22* C9020 FORMAT(20H SUM OF F(1)**2=D27.16)
00111 23* C9025 FORMAT(4H0 X(12,15H) PERTURBED BY D27.16)
00111 24* C
00111 25* C RENAME INPUT ITEMS MX,NY,IDEV.
00112 26* M=MX
00113 27* N=NY
00114 28* EPSL=ABS(EPS)
00115 29* IDER=IDEV
00115 30* C TEST IF TOLERANCE,EPSL, IS ZERO.
00116 31* IF(EPSL)20,10,20
00116 32* C SUBSTITUTE REASONABLE VALUE FOR EPSL.
00121 33* 10 EPSL=1.E-5
00121 34* C INITIALIZE ITERATION COUNTER,NIT = 0. INITIALIZE NO. OF COMPONENTS
00121 35* C TO BE REGARDED IN PERTURBATION OPERATION, IP = 0.
00122 36* 20 NIT=0
00123 37* IP=0
00123 38* C EVALUATE FUNCTION OF GUESS POINT, F(X).
00124 39* CALL FCALC(X,F,S(1),IBLEN)
00124 40* C TEST IF GUESS POINT GOOD.
00125 41* IF(IBLEW)670,40,670
00125 42* C COMPUTE NORM SQUARED,BF, OF FUNCTION AT GUESS POINT.
00130 43* 40 BF=0.
00131 44* DO 50 I=1,N
00134 45* 50 BF=BF+F(I)**2
00134 46* C INITIALIZE BEST VALUE OF NORM SQUARED,BST.
00136 47* BST=BF
00136 48* C TEST IF FINISHING PROCEDURE ONLY IS TO BE USED.
00137 49* IF(IFIN)900,60,900
00142 50* 60 IF (BST),670,
00142 51* C ESTABLISH CONSTRAINT AND PERTURBATION VECTORS ACCORDING TO VECTOR
00142 52* C INTEGER CODES ,IV(1).
00145 53* DO 150 I=1,M
00145 54* C TEST VECTOR OF INTEGERS FOR NON-ZERO COMPONENTS,I.E. DISREGARD
00145 55* C CORRESPONDING COMPONENTS OF X IN ITERATION PROCEDURE
00150 56* IF(IV(I))150,70,150
00153 57* 70 IP=IP+1
00153 58* C TEST VECTOR OF CONSTRAINTS FOR ZERO COMPONENTS.

```

```

TRNBE
BEGS0001
BEGS0002
BEGS0003
BEGS0004
BEGS0005
BEGS0006
BEGS0007
BEGS0008
BEGS0009
BEGS0010
BEGS0011
BEGS0012
BEGS0013
BEGS0014
BEGS0015
BEGS0016
BEGS0017
BEGS0018
BEGS0019
BEGS0020
BEGS0021
BEGS0022
BEGS0023
BEGS0024
BEGS0025
BEGS0026
BEGS0027
BEGS0028
BEGS0029
BEGS0030
BEGS0031
BEGS0032
BEGS0033
BEGS0034
BEGS0035
BEGS0036
BEGS0037
BEGS0038
BEGS0039
BEGS0040
BEGS0041
BEGS0042
BEGS0043
BEGS0044
BEGS0045
BEGS0046
BEGS0047
BEGS0048
BEGS0050
BEGS0051
BEGS0052
BEGS0053
BEGS0054
BEGS0055
BEGS0056
BEGS0057

```

```

00154 59* IF(BNDS(I))100,90,100 BEGS0058
00154 60* C RESET I-TH COMPONENT IF INITIALLY ZERO. BEGS0059
00157 61* 90 BNDS(IP)=10,0 BEGS0060
00160 62* GO TO 110 BEGS0061
00161 63* 100 BNDS(IP)=BNDS(I) BEGS0062
00161 64* C TEST FOR NULL COORDINATE IN PERTURBATION VECTOR-IF ZERO THEN RESET BEGS0063
00162 65* 110 IF(H(I))150,120,150 BEGS0064
00165 66* 120 IF(X(I))130,140,130 BEGS0065
00170 67* 130 H(I)=.01*X(I) BEGS0066
00171 68* GO TO 150 BEGS0067
00172 69* 140 H(I)=.001 BEGS0068
00173 70* 150 CONTINUE BEGS0069
00173 71* C DEFINE INDEX VALUES FOR TEMPORARY STORAGE ARRAY S. BEGS0070
00175 72* JJ=IP*IP BEGS0071
00176 73* JPFF=N*IP BEGS0072
00177 74* JPX=JPFF*N BEGS0073
00200 75* JY=JPX*JJ BEGS0074
00201 76* JAZ=JY+IP BEGS0075
00202 77* JW=JAZ+IP BEGS0076
00203 78* JQ=JW+IP BEGS0077
00204 79* JATA=JQ*JJ BEGS0078
00205 80* JAR=JATA+((IP+1)*(IP+2))/2 BEGS0079
00206 81* JV=JAR+((IP+2)*(IP+3))/2 BEGS0080
00206 82* C INITIALIZE BEST F IN S ARRAY- S(MN+1),...,S(MN+N) BEGS0081
00207 83* DO 170 I=1,N BEGS0082
00212 84* JJ=JPFF*I BEGS0083
00213 85* 170 S(JJ)=F(I) BEGS0084
00213 86* C TEST IF USING TANGENT OR SECANT METHOD. BEGS0085
00215 87* IF(IDER)510,200,510 BEGS0086
00215 88* C IF USING SECANT METHOD, THEN COMPUTE NECESSARY MATRICES APPROXIMATING BEGS0087
00215 89* C MATRIX OF PARTIALS, BY CONSTRUCTING M INDEPENDENT POINTS LOCALLY BEGS0088
00215 90* C SURROUNDING X AND USING THESE M+1 POINTS TO DEFINE A HYPERPLANE BEGS0089
00215 91* C APPROACHING THE ACTUAL TANGENT PLANE AT X --X IS UPDATED AS NEEDED. BEGS0090
00215 92* C PERTURB COMPONENTS OF X AND EVALUATE F SUCCESSIVELY. MAINTAIN BEST BEGS0091
00215 93* C POINT IN X. UPDATE MINIMAL VALUE,BST, AS REQUIRED. OUTCOME WILL BE BEGS0092
00215 94* C M PERTURBED POINTS IN S(NM+N+1),...,S(NM+N+M+2),AND CORRESPONDING BEGS0093
00215 95* C FUNCTION VALUES IN S(1),...,S(MN). BEST PT. IS X,BEST FUNCTION OF BEGS0094
00215 96* C THIS X IS IN S(MN+1),...,S(MN+N). BEGS0095
00220 97* 200 K=0 BEGS0096
00221 98* JD=0 BEGS0097
00222 99* DO 430 I=1,M BEGS0098
00222 100* C SHOULD I-TH COMPONENT OF X BE PERTURBED. BEGS0099
00225 101* IF(IV(I))430,210,430 BEGS0100
00230 102* 210 K=K+1 BEGS0101
00230 103* C PERTURB IT NO LESS THAN (10*(I-6))* X(I). BEGS0102
00231 104* A1=1.E-6*AB(X(I)) BEGS0103
00232 105* IF(AB(H(I))-A1) 220,220,230 BEGS0104
00235 106* 220 H(I)=SIGN(A1,H(I)) BEGS0105
00235 107* C SAVE X(I) TEMPORARILY. BEGS0106
00236 108* 230 P=X(I) BEGS0107
00236 109* C PERTURB X(I) BY H(I). BEGS0108
00237 110* 240 X(I)=H(I)+P BEGS0109
00240 111* IF (X(I)-P)245,,245
00240 112* C ERROR EXIT BEGS0111
00243 113* IF(NIT,EQ.0) NIT=1 BEGS0112
00245 114* NIT=NIT BEGS0113
00246 115* GO TO 650 BEGS0114
00246 116* C COMPUTE F FOR NEW POINT BEGS0115

```

```

00247 117* 245 CALL FCALC(S,IBLEW) BEGS0116
00247 118* C TEST IF POINT IS GOOD. IF NOT, REVERSE H(1),HALVE, AND TRY AGAIN. BEGS0117
00250 119* IF(IBLEW)280,250,280 BEGS0118
00250 120* C COMPUTE NORM SQUARED FOR NEW POINT X. BEGS0119
00253 121* 250 BF=0. BEGS0120
00254 122* DO 260 J=1,N BEGS0121
00257 123* 260 BF=BF+F(J)**2 BEGS0122
00257 124* C IF F**2 TOO LARGE, HALVE STEP AND REPEAT. BEGS0123
00261 125* IF(BF-.E36)290,280,280 BEGS0124
00264 126* 280 H(1)=-H(1)/2.0 BEGS0125
00265 127* GO TO 240 BEGS0126
00265 128* C UPDATE STEP SIZE AND DIRECTION DEPENDING ON SIGNED CHANGE IN F**2. BEGS0127
00265 129* C UP STEP SIZE BY 5 IF RELATIVE CHANGE IN F**2 IS VERY SMALL. BEGS0128
00265 130* C DIRECTION OF THIS CHANGE IS TOWARD SMALLEST VALUE OF BF,BST. BEGS0129
00266 131* 290 IF(AB((BF-BST)/BST)-1.E-7) 300,300,310 BEGS0130
00271 132* 300 H(1)=SIGN(5.0*H(1),(BST-BF)*H(1)) BEGS0131
00272 133* GO TO 360 BEGS0132
00272 134* C IS NEW F BETTER. BEGS0133
00273 135* 310 IF(BF-BST)320,320,340 BEGS0134
00273 136* C NEW F IS BETTER. IF RELATIVE CHANGE IN F**2 IS LESS THAN .5 BEGS0135
00273 137* C THEN UP STEP SIZE BY 5. BEGS0136
00276 138* 320 IF((BST-BF)/BST-.5)330,330,360 BEGS0137
00301 139* 330 H(1)=5.0*H(1) BEGS0138
00302 140* GO TO 360 BEGS0139
00302 141* C NEWFNOT BETTER, REVERSE STEP DIRECTION. BEGS0140
00303 142* 340 H(1)=-H(1) BEGS0141
00303 143* C IF RELATIVE CHANGE IN F**2 IS GREATER THAN .5 THEN REDUCE STEP BEGS0142
00303 144* C SIZE BY 1/5. BEGS0143
00304 145* IF((BF-BST)/BST-.5)360,360,350 BEGS0144
00307 146* 350 H(1)=H(1)/5.0 BEGS0145
00307 147* C DEFINE START INDEX IN S ARRAY FOR STORAGE OF SUCCESSIVE COMPONENTS BEGS0146
00307 148* C OF X WHICH ARE CONSIDERED IN ITERATIVE PROCEDURE. BEGS0147
00310 149* 360 JZ=JPX+(K-1)*IP BEGS0148
00310 150* C SET APPROPRIATE ENTRIES IN S VECTOR TO ABOVE X COMPONENTS. BEGS0149
00311 151* K1=0 BEGS0150
00312 152* DO 380 J=1,M BEGS0151
00315 153* IF(IV(J))380,370,380 BEGS0152
00320 154* 370 K1=K1+1 BEGS0153
00321 155* JJ=JZ+K1 BEGS0154
00322 156* S(JJ)=X(J) BEGS0155
00323 157* 380 CONTINUE BEGS0156
00323 158* C IS NEW F BETTER. THIS QUESTION IS ASKED TO DETERMINE WHETHER BEGS0157
00323 159* C LAST BEST POINT SHOULD BE UPDATED. BEGS0158
00325 160* IF(BF-BST)390,390,410 BEGS0159
00325 161* C NEW F IS BETTER. BEGS0160
00330 162* 390 JZ=JZ+K BEGS0161
00330 163* C PUT PREVIOUS X(1) IN S ARRAY. BEGS0162
00331 164* S(JZ)=P BEGS0163
00332 165* DO 400 J=1,N BEGS0164
00335 166* JD=JD+1 BEGS0165
00336 167* JK=JPFF+J BEGS0166
00336 168* C STORE PREVIOUS FUNCTION VALUE IN APPROPRIATE BEGS0167
00336 169* C SECTION OF S(1),...,S(MN). BEGS0168
00337 170* S(JD)=-S(JK) BEGS0169
00337 171* C STORE NEW FUNCTION VALUE IN S(MN+1),...,S(MN+N). BEGS0170
00340 172* 400 S(JK)=-F(J) BEGS0171
00342 173* BST=BF BEGS0172
00343 174* IF (BST),650,

```

```

00346 175* GO TO 430
00346 176* C. NEWFNOT BETTER. SET APPROPRIATE SECTION OF S(1),...,S(MN) TO
00346 177* C NEW FUNCTION VALUE.
00347 178* 410 DO 420 J=1,N
00352 179* JD=JD+1
00353 180* 420 S(JD)=F(J)
00355 181* X(J)=P
00355 182* C REPEAT FOR MORE COMPONENTS.
00356 183* 430 CONTINUE
00356 184* C HAVE SET OF PERTURBED POINTS, AND A BEST POINT. COMPUTE P,Q-MATRICES
00356 185* C USED IN SECANT METHOD.
00360 186* 440 K=0
00361 187* K1=0
00362 188* DO 480 I=1,IP
00362 189* C COMPUTE POINT DIFFERENCES FOR Q-MATRIX,
00362 190* C S(MN+N+1),...,S(MN+N+M+2).
00365 191* DO 460 J=1,M
00370 192* IF(IY(J))460,450,460
00373 193* 450 K=K+1
00374 194* IX=JPX+K
00375 195* IQ=JQ+K
00376 196* S(IQ)=S(IX)-X(J)
00377 197* 460 CONTINUE
00377 198* C COMPUTE FUNCTION DIFFERENCES IN P-MATRIX, S(1),...,S(MN)
00401 199* DO 470 J=1,N
00404 200* IPF=JPPF+J
00405 201* K1=K1+1
00406 202* 470 S(K1)=S(K1)+S(IPF)
00410 203* 480 CONTINUE
00412 204* JON=0
00413 205* IRX=0
00414 206* IRV=JV
00414 207* C DETERMINE DX= ITERATIVE CHANGE IN X, FOR SECANT METHOD.
00414 208* C SOLVE PY = -F FOR Y.
00415 209* 490 CALL LEGS(S(1),S(JY+1),BNDS,N,IP,N,IP,
00415 210* IS(JATA+1),S(JAR+1),T,SUS,SUP,IBNDS,0,0,0,0)
00415 211* C COMPUTE DX = QY. STORE IN S(NM+N+M+2+M) SUBVECTOR.
00416 212* DO 500 I=1,IP
00421 213* IZ=JAZ+1
00422 214* S(IZ)=0.
00423 215* DO 500 J=1,IP
00426 216* IQ=JQ+(J-1)*IP+1
00427 217* IY=JY+J
00430 218* 500 S(IZ)=S(IZ)+S(IQ)*S(IY)
00430 219* C UPDATE MATRIX ITERATION COUNT FOR THESE P,Q.
00433 220* JON=JON+1
00434 221* GO TO 520
00434 222* C DETERMINE DX DIRECTLY, IF USING TANGENT METHOD, FROM A(DX) = -F,
00434 223* C WHERE A IS MATRIX OF PARTIALS STORED IN S(1),...,S(MN) BY SUBROUTINE
00434 224* C FCALC. STORE DX IN S(NM+N+M+2+M) SUBVECTOR.
00435 225* 510 CALL LEGS(S(1),S(JAZ+1),BNDS,N,IP,N,IP,
00435 226* IS(JATA+1),S(JAR+1),T,SUS,SUP,IBNDS,0,0,0,0)
00436 227* 520 I=0
00437 228* DO 540 K=1,M
00442 229* IF(IY(K))540,530,540
00445 230* 530 I=I+1
00446 231* IW=JW+1
00447 232* IZ=JAZ+1

```

BEGS0174
 BEGS0175
 BEGS0176
 BEGS0177
 BEGS0178
 BEGS0179
 BEGS0180
 BEGS0181
 BEGS0182
 BEGS0183
 BEGS0184
 BEGS0185
 BEGS0186
 BEGS0187
 BEGS0188
 BEGS0189
 BEGS0190
 BEGS0191
 BEGS0192
 BEGS0193
 BEGS0194
 BEGS0195
 BEGS0196
 BEGS0197
 BEGS0198
 BEGS0199
 BEGS0200
 BEGS0201
 BEGS0202
 BEGS0203
 BEGS0204
 BEGS0205
 BEGS0206
 BEGS0207
 BEGS0208
 BEGS0209
 BEGS0210
 BEGS0211
 BEGS0212
 BEGS0213
 BEGS0214
 BEGS0215
 BEGS0216
 BEGS0217
 BEGS0218
 BEGS0219
 BEGS0220
 BEGS0221
 BEGS0222
 BEGS0223
 BEGS0224
 BEGS0225
 BEGS0226
 BEGS0227
 BEGS0228
 BEGS0229
 BEGS0230
 BEGS0231

```

00447 233* C SAVE PREVIOUS X VECTOR THIS LAST MATRIX ITERATION, IN S(NM+N+M**2+2M) SBE
00447 234* C SUBVECTOR. BEGS0233
00450 235* S(IW)=X(K) BEGS0234
00450 236* C COMPUTE NEW X FROM DX AND OLD X. BEGS0235
00451 237* X(K)=S(IW)+S(IZ) BEGS0236
00452 238* 540 CONTINUE BEGS0237
00452 239* C UP ITERATION COUNT BY 1. BEGS0238
00454 240* NIT=NIT+1 BEGS0239
00455 241* IF(IDER)550,570,550 BEGS0240
00455 242* C SAVE LAST POINT PARTIALS, IF USING TANGENT METHOD. NOTE--A SIMILAR THIN BEGS0241
00455 243* C WAS DONE FOR Q-MATRIX WHEN USING SECANT METHOD. BEGS0242
00460 244* 550 DO 560 K=1,JPFF BEGS0243
00463 245* IQ=JV+K BEGS0244
00464 246* 560 S(IQ)=S(K) BEGS0245
00464 247* C COMPUTE NEW F AND F**2. BEGS0246
00466 248* 570 CALL FCALC(X,F,S(I),IBLEW) BEGS0247
00467 249* BF=0. BEGS0248
00470 250* DO 580 I=1,N BEGS0249
00473 251* 580 BF=BF+F(I)**2 BEGS0250
00475 252* GO TO 680 BEGS0251
00475 253* C FINAL SEQUENCE OF STATEMENTS ENDING PROGRAM. BEGS0252
00475 254* C TEST IF PRESENT NORM SQUARED BETTER THAN LAST. BEGS0253
00476 255* 590 IF(BF-BST)640,640,600 BEGS0254
00476 256* C RESET BEST X. BEGS0255
00501 257* 600 DO 620 I=1,M BEGS0256
00504 258* IF(IV(I))620,610,620 BEGS0257
00507 259* 610 JW=JW+1 BEGS0258
00510 260* X(I)=S(JW) BEGS0259
00511 261* 620 CONTINUE BEGS0260
00511 262* C SET FUNCTION F TO LAST BEST VALUE. BEGS0261
00513 263* DO 630 I=1,N BEGS0262
00516 264* JPFF=JPFF+1 BEGS0263
00517 265* 630 F(I)=S(JPFF) BEGS0264
00521 266* GO TO 650 BEGS0265
00521 267* C UPDATE BEST F**2. BEGS0266
00522 268* 640 BST=BF BEGS0267
00522 269* C NULL OUT CONSTRAINT VECTOR. BEGS0268
00523 270* 650 DO 660 J=1,M BEGS0269
00526 271* H(J)=0.0 BEGS0270
00527 272* 660 BND(S(J))=0.0 BEGS0271
00531 273* 670 BSST=BST BEGS0272
00532 274* RETURN BEGS0273
00532 275* C BEGS0274
00532 276* C BEGS0275
00533 277* 680 K=0 BEGS0276
00533 278* C IS POINT GOOD. BEGS0277
00534 279* IF(IBLEW)690,700,690 BEGS0278
00534 280* C TEST NO. OF ITERATIONS. BEGS0279
00537 281* 690 IF(MAXIT-NIT)600,600,840 BEGS0280
00542 282* 700 DO 720 I=1,M BEGS0281
00545 283* IF(IV(I))720,710,720 BEGS0282
00550 284* 710 K=K+1 BEGS0283
00551 285* IZ=JAZ+K BEGS0284
00551 286* C PERFORM RELATIVE CONVERGENCE TEST. BEGS0285
00552 287* IF(ABS(S(IZ)).GT. ABS(X(I)*EPSL)) GO TO 730 BEGS0286
00554 288* 720 CONTINUE BEGS0287
00556 289* GO TO 590 BEGS0288
00557 290* 730 IF(MAXIT-NIT)590,590,740 BEGS0289

```

```

00557 291* C IS NEW F BETTER. BEGS0290
00562 292* 740 IF(BF=BS)750,750,840 BEGS0291
00562 293* C NEW F IS BETTER, DOUBLE VALUES IN CONSTRAINT VECTOR. BEGS0292
00565 294* 750 DO 760 K=1,1P BEGS0293
00570 295* 760 BND5(K)=BND5(K)*2.0 BEGS0294
00570 296* C UPDATE BEST NORM SQUARED VALUE. BEGS0295
00572 297* BS=BF BEGS0296
00572 298* C IF USING TANGENT METHOD THEN UPDATE BEST F IN BEGS0297
00572 299* C S ARRAY, I.E., UPDATE CONSTANT MATRIX BEGS0298
00573 300* IF(IDR)820,770,820 BEGS0299
00573 301* C UPDATE LAST BEST X--FROM S(NM+N+M*2+2M) TO S(NM+N) SUBVECTOR SECTION. BEGS0300
00576 302* 770 DO 780 I=1,1P BEGS0301
00601 303* IRX=IRX+1 BEGS0302
00602 304* JJ=JFX+IRX BEGS0303
00603 305* IW=JW+I BEGS0304
00604 306* 780 S(JJ)=S(IW) BEGS0305
00606 307* DO 790 I=1,N BEGS0306
00611 308* IRV=IRV+I BEGS0307
00612 309* IFS=JFFF+I BEGS0308
00612 310* C SAVE LAST BEST F --FROM S(NM+1) TO OTHER HIGH INDEXED SECTION. BEGS0309
00613 311* S(IRV)=S(IFS) BEGS0310
00613 312* C UPDATE BEST F -- TO S(NM+1) SUBVECTOR. BEGS0311
00614 313* 790 S(IFS)=F(I) BEGS0312
00614 314* C TEST TO SEE IF P,Q NEED BE UPDATED. IF NO, THEN PERFORM ANOTHER SECANT BEGS0313
00614 315* C ITERATION. BEGS0314
00616 316* IF(JON-1P)490,800,800 BEGS0315
00616 317* C UPDATE S(I),...,S(MN) TO PAST BEST FUNCTION VALUES. TRANSFER TO SECTIO BEGS0316
00616 318* C WHICH UPDATES P,Q MATRICES. BEGS0317
00621 319* 800 K=0 BEGS0318
00622 320* DO 810 I=1,N BEGS0319
00625 321* DO 810 J=1,1P BEGS0320
00630 322* K=K+1 BEGS0321
00631 323* IRV=JV+K BEGS0322
00632 324* 810 S(K)=S(IRV) BEGS0323
00635 325* GO TO 440 BEGS0324
00636 326* 820 DO 830 I=1,N BEGS0325
00641 327* J=JFFF+I BEGS0326
00642 328* 830 S(J)=F(I) BEGS0327
00644 329* GO TO 510 BEGS0328
00644 330* C NEW F NOT BETTER. BEGS0329
00645 331* 840 IF(IDR) 845,847,845 BEGS0330
00650 332* 845 IF(1BND5.EQ.0) GO TO 510 BEGS0331
00652 333* 847 I=0 BEGS0332
00653 334* DO 860 K=1,M BEGS0333
00656 335* IF(1V(K))860,850,860 BEGS0334
00661 336* 850 I=I+1 BEGS0335
00661 337* C REDUCE CONSTRAINT VECTOR BY 1/5. BEGS0336
00662 338* BND5(I)=BND5(I)/5.0 BEGS0337
00663 339* IW=JW+I BEGS0338
00664 340* X(K)=S(IW) BEGS0339
00665 341* 860 CONTINUE BEGS0340
00665 342* C RESET FUNCTION F TO LAST BEST VALUES IN S(NM+1) SUBVECTOR. BEGS0341
00667 343* DO 870 K=1,M BEGS0342
00672 344* JJ=JFFF+K BEGS0343
00673 345* 870 F(K)=S(JJ) BEGS0344
00675 346* BF=BS BEGS0345
00675 347* C TRANSFER TO SECTION FOR ANOTHER ATTEMPT AT COORDINATE STEPPING,IF BEGS0346

```

```

00676 349* IF, I DER, 880, 5, 880
00701 350* 875 IF (EPS, GE, 0) GO TO 200
00703 351* WRITE(6, 8995) JON, NIT
00707 352* 8995 FORMAT(45H NORM SQUARED WORSE THAN PREVIOUS VALUE AFTER,
00707 353* 1 14,26H CONSTANT SLOPE ITERATIONS, 10X,
00707 354* 2 17H TOTAL ITERATIONS=13)
00710 355* GO TO 200
00710 356* C RESET COEF. MATRIX TO PREVIOUS VALUE, IF USING TANGENT METHOD.
00711 357* 880 DO 890 I=1, JPF
00714 358* IQ=JV+I
00715 359* 890 S(I)=S(IQ)
00715 360* C TRANSFER TO AREA FOR ANOTHER TANGENT ITERATION, WITH THE REDUCED
00715 361* C CONSTRAINT VECTOR.
00717 362* GO TO 510
00717 363* C START FINISHING PROCEDURE TO TEST WHETHER INPUT X IS MINIMAL.
00720 364* 900 JPF=M*N
00721 365* JH=JPF+N
00722 366* JZ=JH+M
00723 367* WRITE(6, 9000)
00725 368* 9000 FORMAT(44H0 FINISHING PROCEDURE WITH FOLLOWING NOMINAL)
00726 369* WRITE(6, 9010) (X(IPR), IPR=1, M)
00734 370* WRITE(6, 9015) (F(IPR), IPR=1, N)
00742 371* IF (BF-BST) 920, 920, 930
00745 372* 920 WRITE(6, 9005) BF
00750 373* GO TO 940
00751 374* 930 WRITE(6, 9020) BF
00754 375* 940 DO 1040 I=1, M
00757 376* IF (IY(I)) 1040, 950, 1040
00762 377* 950 IF (H(I)) 970, 960, 970
00765 378* 960 H(I)=EPSL*X(I)
00766 379* 970 P=X(I)
00766 380* C PERTURB I-TH COMPONENT, X(I), +H(I) AND -H(I), FOR EACH I. LOOK FOR
00766 381* C SMALLER VALUES IN F**2 AND SAVE ACCORDINGLY.
00766 382* C TRANSFER TO PROGRAM RETURN.
00767 383* JAR=JZ+1
00770 384* JATA=JZ+N
00771 385* DO 1030 J=1, 2
00774 386* X(I)=P+H(I)
00775 387* CALL FCALC(X, S(JZ+1), S, IBLEN)
00776 388* SF=0.
00777 389* DO 980 K=1, N
01002 390* IZ=JZ+K
01003 391* 980 SF=SF+S(IZ)**2
01005 392* WRITE(6, 9025) I, H(I)
01011 393* WRITE(6, 9010) (X(K), K=1, M)
01017 394* WRITE(6, 9015) (S(K), K=JAR, JATA)
01025 395* IF (BSY-SF) 1020, 990, 990
01030 396* 990 WRITE(6, 9005) SF
01033 397* DO 1000 JJ=1, M
01036 398* IH=JJ+JH
01037 399* 1000 S(IH)=X(JJ)
01041 400* DO 1010 JJ=1, N
01044 401* IZ=JZ+JJ
01045 402* IFF=JPF+JJ
01046 403* 1010 S(IPP)=S(IZ)
01050 404* BST=SF
01051 405* GO TO 1030
01052 406* 1020 WRITE(6, 9020) SF

```

```

BEGS0348
BEGS0349
BEGS0350
BEGS0351
BEGS0352
BEGS0353
BEGS0354
BEGS0355
BEGS0356
BEGS0357
BEGS0358
BEGS0359
BEGS0360
BEGS0361
BEGS0362
BEGS0363
BEGS0364
BEGS0365
BEGS0366
BEGS0367
BEGS0368
BEGS0369
BEGS0370
BEGS0371
BEGS0372
BEGS0373
BEGS0374
BEGS0375
BEGS0376
BEGS0377
BEGS0378
BEGS0379
BEGS0380
BEGS0381
BEGS0382
BEGS0383
BEGS0384
BEGS0385
BEGS0386
BEGS0387
BEGS0388
BEGS0389
BEGS0390
BEGS0391
BEGS0392
BEGS0393
BEGS0394
BEGS0395
BEGS0396
BEGS0397
BEGS0398
BEGS0399
BEGS0400
BEGS0401
BEGS0402
BEGS0403
BEGS0404
BEGS0405

```

		@	FOR,*	BEGS,BEGS		DATE	310871	PAGE	90
01055	407*	1030	H(I)=H(I)					BEGS0406	
01057	408*		X(I)=P					BEGS0407	
01060	409*	1040	CONTINUE					BEGS0408	
01062	410*		GO TO 590					BEGS0409	
01063	411*		END					BEGS0410	
END OF UNIVAC 1108 FORTRAN V COMPILATION.					O *DIAGNOSTIC* MESSAGE(S)				
BEGS			SYMBOLIC		30 APR 71	11:18:54	0	01440312	14 411 (DELETED)
BEGS	CODE		RELOCATABLE		30 APR 71	11:18:54	1	01453504	24 1 (DELETED)
							0	01453534	14 123
B HDG		@	FOR,*	BETA,BETA					

31 AUG 71

9:26:38.863

@ FOR,* BETA,BETA
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:26:39

FUNCTION BETA ENTRY POINT 000127

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000156
 0000 *DATA 000033
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

32 0001 000031 10L 0001 000052 116G 0001 000043 20L 0001 000063 40L 0000 R 000000 BETA
 0000 I 000002 I 0000 I 000001 M1

```

00101 10 FUNCTION BETA (Y,X,XIN,M)
00103 20 DIMENSION X(20), Y(20)
00104 30 IF( XIN .GT. X(1) ) GO TO 10
00106 40 BETA = Y(1)
00107 50 RETURN
00110 60 10 IF( XIN .LT. X(M) ) GO TO 20
00112 70 BETA = Y(M)
00113 80 RETURN
00113 90 C
00113 100 C FIND I SUCH THAT X(I) .LE. XIN .LE. X(I+1)
00114 110 20 M1 = M-1
00115 120 DO 30 I=1,M1
00120 130 IF ( X(I+1) .GE. XIN ) GO TO 40
00123 140 BETA = Y(I) + (Y(I+1)-Y(I))*((XIN-X(I))/(X(I+1)-X(I)))
00124 150 RETURN
00125 160 END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

BETA	CODE	SYMBOLIC	RELOCATABLE	14 JUN 71	15:05:17	0	01612364	14	16	(DELETED)
BETA				14 JUN 71	15:05:17	1	01612724	24	1	(DELETED)
						0	01612754	14	12	

@ HDG @ FOR,* BINSER,BINSER

3.2.7 BISNER

FOR,• BINSER,BINSER
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:26:40

31 AUG '71

9:26:39.979

SUBROUTINE BINSER ENTRY POINT 000137

STORAGE USED (BLOCK, NAME, LENGTH)

```
0001  *CODE  000172
0000  *DATA  000023
0002  *BLANK 000000
```

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

```

0001 000024 10L      0001 000027 20L      0001 000037 30L      0001 000057 50L      0001 000061 60L
0001 000124 70L      0000 R 000002 DELTT  0000 ; 000000 INDEX  0000 R 000001 SIGN

```

```
00100      1*   CD* * * * * BINS0010
00100      2*   CD                                BINS0020
00100      3*   CD    PROGRAMMER AND DATE          BINS0030
00100      4*   CD                J. I. PREWITT     BINS0040
00100      5*   CD                DECEMBER 1970     BINS0050
00100      6*   CD                                BINS0060
00100      7*   CD    PURPOSE                      BINS0070
00100      8*   CD                PERFORMS A BINARY SEARCH TO OBTAIN ITS INDICE AND
00100      9*   CD                INTERPOLATION FUNCTION, BINS0080
00100     10*   CD                                BINS0090
00100     11*   CD    USAGE                        BINS0100
00100     12*   CD                CALL BINSER (T,UB,JMAX,JJ,B) BINS0110
00100     13*   CD                                BINS0120
00100     14*   CD    DESCRIPTION OF PARAMETERS    BINS0130
00100     15*   CD                                BINS0140
00100     16*   CD        INPUT                    BINS0150
00100     17*   CD            CALLING SEQUENCE      BINS0160
00100     18*   CD                T - VALUE TO BE SEARCHED FOR BINS0170
00100     19*   CD                UB - ARRAY TO BE SEARCHED    BINS0180
00100     20*   CD                JMAX - LENGTH OF UB         BINS0190
00100     21*   CD            COMMON                 BINS0200
00100     22*   CD                NONE               BINS0210
00100     23*   CD            CARD                   BINS0220
00100     24*   CD                NONE              BINS0230
00100     25*   CD            TAPE                   BINS0240
00100     26*   CD                NONE              BINS0250
00100     27*   CD                                BINS0260
00100     28*   CD                                BINS0270
00100     29*   CD    OUTPUT                       BINS0280
00100     30*   CD                                BINS0290
```

```

00100 30* CD CALLING SEQUENCE BINS0300
00100 31* CD JJ = INDEX OF THE UB ARRAY, I.E. T .LE. UB(JJ) BINS0310
00100 32* CD B = INTERPOLATION FUNCTION BINS0320
00100 33* CD COMMON BINS0330
00100 34* CD NONE BINS0340
00100 35* CD CARD BINS0350
00100 36* CD NONE BINS0360
00100 37* CD PRINT BINS0370
00100 38* CD NONE BINS0380
00100 39* CD TAPE BINS0390
00100 40* CD NONE BINS0400
00100 41* CD BINS0410
00100 42* CD REMARKS AND RESTRICTIONS BINS0420
00100 43* CD TEST TO MAKE SURE T IS WITHIN THE RANGE UB(1) - UB(JMAX) BINS0430
00100 44* CD HAS TO BE MADE BEFORE ENTRY IN TO THIS ROUTINE. BINS0440
00100 45* CD BINS0450
00100 46* CD SUBPROGRAMS REQUIRED BINS0460
00100 47* CD NONE BINS0470
00100 48* CD BINS0480
00100 49* CD METHOD BINS0490
00100 50* CD T IS COMPARED TO THE UB ARRAY UNTIL T LIES BETWEEN TWO BINS0500
00100 51* CD VALUES IN THE UB ARRAY OR UNTIL T IS EQUAL TO A VALUE BINS0510
00100 52* CD IN THE UB ARRAY. THEN THE INTERPOLATION FUNCTION IS BINS0520
00100 53* CD COMPUTED. BINS0530
00100 54* CD BINS0540
00100 55* CD * * * * * BINS0550
00100 56* C BINS0560
00101 57* SUBROUTINE BINSER (T,UB,JMAX,JJ,B) BINS0570
00101 58* C BINS0580
00103 59* DIMENSION UB(1) BINS0590
00103 60* C BINS0600
00104 61* JJ = (JMAX+1) / 2 BINS0610
00105 62* INDEX = (JJ+1) / 2 BINS0620
00106 63* SIGN = UB(JMAX) - UB(1) BINS0630
00106 64* C BINS0640
00107 65* GO TO 30 BINS0650
00107 66* C BINS0660
00107 67* C INCREMENT BINS0670
00107 68* C BINS0680
00110 69* 10 JJ = JJ + INDEX BINS0690
00110 70* C BINS0700
00110 71* C TEST END OF SEARCH BINS0710
00110 72* C BINS0720
00111 73* 20 IF (INDEX.EQ.1) GO TO 60 BINS0730
00113 74* INDEX = INDEX - INDEX/2 BINS0740
00113 75* C BINS0750
00113 76* C TEST RANGE BINS0760
00113 77* C BINS0770
00114 78* 30 IF (SIGN(T,SIGN)*SIGN(UB(JJ),SIGN)) 40,50,10 BINS0780
00114 79* C BINS0790
00114 80* C DECREMENT BINS0800
00114 81* C BINS0810
00117 82* 40 JJ = JJ - INDEX BINS0820
00120 83* GO TO 20 BINS0830
00120 84* C BINS0840
00120 85* C T .EQ. UB(JJ) BINS0850
00120 86* C BINS0860
00121 87* 50 CONTINUE BINS0870

```

	#	FOR,*	BINSER,BINSER	DATE 310871	PAGE	94
00122	88*		B = 0.		BINS0880	
00123	89*		GO TO 70		BINS0890	
00124	90*		60 CONTINUE		BINS0900	
00124	91*	C			BINS0910	
00124	92*	C	INTERPOLATION FUNCTION		BINS0920	
00124	93*	C			BINS0930	
00125	94*		IF (SIGN(T,SIGN) .GT. SIGN(UB(JJ),SIGN)) JJ = JJ+1		BINS0940	
00127	95*		DELT = UB(JJ)-UB(JJ-1)		BINS0950	
00130	96*		IF (ABS(DELT).LT..00005) GO TO 50		BINS0960	
00132	97*		B = (T-UB(JJ)) / DELT		BINS0970	
00132	98*	C			BINS0980	
00133	99*		70 CONTINUE		BINS0990	
00134	100*		RETURN		BINS1000	
00135	101*		END		BINS1010	

END OF UNIVAC 1108 FORTRAN V COMPILATION.			D *DIAGNOSTIC* MESSAGE(S)				
BINSER	SYMBOLIC	01 MAR 71	18:47:30	0	01533770	14	101 (DELETED)
BINSER	CODE	30 APR 71	11:18:57	1	01457026	24	1 (DELETED)
				0	01457056	14	13
# HDG	#	FOR,*	BLK1,BLK1				

FOR, BLK1, BLK1
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:26:41

31 AUG 71

9:26:41.420

BLOCK DATA

STORAGE USED (BLOCK, NAME, LENGTH)

0003 BLKPTH 002116

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0003 R 000000 AA	0003 R 000127 AB	0003 R 000220 AC	0003 R 000367 AD	0003 R 000404 AE
0003 R 000547 AF	0003 R 000571 AG	0003 R 000723 AH	0003 R 001055 AI	0003 R 001217 AJ
0003 R 001251 AK	0003 R 001417 AL	0003 R 001516 AM	0003 R 001573 AN	0003 R 001742 AO
0000 I 000000 1s				

36

00100	1*	CD	*****	BLK10010
00100	2*	CD		BLK10020
00100	3*	CD	PROGRAMMER AND DATE	BLK10030
00100	4*	CD	NATIONAL BUREAU OF STANDARDS	BLK10040
00100	5*	CD	1967	BLK10050
00100	6*	CD		BLK10060
00100	7*	CD	DOCUMENTATION AND DATE	BLK10070
00100	8*	CD	J. I. PREWITT	BLK10080
00100	9*	CD	DECEMBER 1970	BLK10090
00100	10*	CD		BLK10100
00100	11*	CD	PURPOSE	BLK10110
00100	12*	CD		BLK10120
00100	13*	CD	INITIALIZATION OF TABLES FOR HPTH (ENTHALPY OF HYDROGEN)	BLK10130
00100	14*	CD		BLK10140
00100	15*	CD	USAGE	BLK10150
00100	16*	CD	BLOCK DATA	BLK10160
00100	17*	CD		BLK10170
00100	18*	CD	DESCRIPTION OF PARAMETERS	BLK10180
00100	19*	CD		BLK10190
00100	20*	CD	INPUT	BLK10200
00100	21*	CD	NONE	BLK10210
00100	22*	CD		BLK10220
00100	23*	CD		BLK10230
00100	24*	CD	OUTPUT	BLK10240
00100	25*	CD	COMMON	BLK10250
00100	26*	CD	UNKNOWN	BLK10260
00100	27*	CD		BLK10270
00100	28*	CD	REMARKS AND RESTRICTIONS	BLK10280
00100	29*	CD	THIS BLOCK DATA ROUTINE IS LOADED INTO CORE EVERY TIME	BLK10290
00100	30*	CD	THE FUNCTION HPTH IS LOADED INTO CORE.	BLK10300
00100	31*	CD		BLK10310
00100	32*	CD	SUBPROGRAMS REQUIRED	BLK10320
00100	33*	CD	NONE	BLK10330
00100	34*	CD		BLK10340
00100	35*	CD	METHOD	BLK10350

```

00100 36* CD
00100 37* CD
00100 38* CD
00100 39* CD
00100 40* CD
00100 41* CD
00100 42* CD
00100 43* CD
00100 44* CD
00100 45* CD
00101 46*
00102 47*
00102 48*
00103 49*
00103 50*
00103 51*
00103 52*
00103 53*
00103 54*
00103 55*
00103 56*
00103 57*
00103 58*
00105 59*
00105 60*
00105 61*
00105 62*
00105 63*
00105 64*
00105 65*
00105 66*
00107 67*
00107 68*
00107 69*
00107 70*
00107 71*
00107 72*
00107 73*
00107 74*
00107 75*
00107 76*
00111 77*
00111 78*
00111 79*
00113 80*
00113 81*
00113 82*
00113 83*
00113 84*
00113 85*
00113 86*
00113 87*
00113 88*
00113 89*
00115 90*
00115 91*
00115 92*
00117 93*

```

THIS ROUTINE WAS OBTAINED FROM NASA/MSC AND IS PART OF
 NBS COMPUTER PROGRAMS FOR THERMODYNAMIC AND TRANSPORT
 PROPERTIES OF HYDROGEN FROM 1 TO 5000 PSIA AND FOR
 TEMPERATURES FROM THE TRIPLE POINT (ABOUT 24.16 O R)
 TO 5000. O R . AUTHORS ARE A.J.HALL, R.D.MCCARTY AND
 H.M.RODER , NBS REPORT NO 9288 , AUGUST 18, 1967,
 PP 188 , NASA NO N67-35527

BLOCK DATA
 COMMON /BLKPTH/ AA(87),AB(57),AC(103),AD(13),AE(99),AF(18),AG(90),
 AH(90),AI(98),AJ(26),AK(102),AL(63),AM(45),AN(103),AO(108)
 DATA AA /10718.,10748.,10777.,12691.,12720.,12754.,
 114783.,14783.,14809.,17057.,16960.,16959.,19701.,19333.,19260.,
 210716.,10722.,10728.,12714.,12699.,12701.,14922.,14807.,14783.,
 317616.,17141.,17026.,21389.,19939.,19578.,10718.,10719.,10720.,
 412730.,12714.,12705.,15023.,14907.,14853.,18003.,17547.,17331.,
 522558.,21174.,20519.,10718.,10718.,10719.,11515.,11501.,
 611496.,11519.,12356.,12322.,12309.,12318.,13258.,13180.,13152.,
 713162.,14255.,14093.,14036.,14049.,15404.,15094.,14984.,14936.,
 816783.,16223.,16026.,16026.,18497.,17539.,17201.,17116.,20676.,
 919114.,18562.,18433.,23483.,21035.,20170.,19976.,27103.,23409./
 DATA AB /BLK10590
 A22100.,21520.,10718.,10718.,10718.,10718.,10718.,11538.,11522.,
 B11515.,11511.,11508.,12414.,12374.,12357.,12346.,12339.,13386.,
 C13297.,13258.,13235.,13219.,14517.,14335.,14255.,14207.,14174.,
 D15904.,15557.,15403.,15311.,15249.,17684.,17059.,16781.,16616.,
 E16503.,20035.,18967.,18493.,18211.,18018.,23183.,21442.,20670.,
 F20209.,19895.,27393.,24679.,23472.,22751.,22259.,32955.,28899.,
 G27084.,25999.,25256./
 DATA AC /1663., 1748., 3407., 3524., 5151., 5272.,
 1 6935., 7056., 8783., 8901.,10718.,10817.,419.7, 385.5, 377.1,
 2385.1,401.5,830.7,823.8,826.2,835.9,851.0,1261.,1270.,1282.,1297.,
 31315.,1668.,1687.,1706.,1724.,1743.,102.2,129.1,159.0,159.9,182.2,8LK10700
 4209.4,221.1,238.9,284.8,299.1,321.3,350.8,362.7,383.0,419.0,8LK10710
 5429.4,446.8,88.34,86.30,87.94,91.61,96.51,102.2,162.4,155.2,152.9,8LK10720
 6153.5,156.1,159.9,232.5,224.0,219.6,218.2,218.9,221.1,299.0,291.1,8LK10730
 7286.2,284.0,280.7,284.8,364.3,357.6,353.2,350.8,350.1,350.8,431.8,8LK10740
 8424.8,422.9,420.9,418.9,419.0,126.4,109.2,98.33,91.88,88.34,201.9,8LK10750
 9188.4,177.2,168.7,162.4,265.3,255.1,1246.2,238.6,232.5,325.1,317.4/8LK10760
 DATA AD/BLK10770
 A310.4,304.2,299.0,384.9,378.8,373.4,368.5,364.3,448.8,444.5,440.3,8LK10780
 B436.0,431.8/
 DATA AE /222.2,174.7,126.4,266.9,233.7,201.9,313.5, 8LK10800
 1288.4,265.3,362.4,342.7,325.1,414.5,398.7,384.9,465.8,457.3,448.8,8LK10810
 236.57,-0.635,35.58,-24.27,11.37,46.52,-10.41,24.51,59.14,5.035, 8LK10820
 339.10,73.14,22.05,54.99,88.32,40.42,72.09,104.7,59.98,90.22,122.0,8LK10830
 480.60,109.3,140.1,102.2,129.1,159.0,-85.55,-76.17,-66.88,-57.67, 8LK10840
 5-48.54,-39.65,-76.14,-67.02,-57.86,-48.74,-39.63,-30.42,-65.46, 8LK10850
 6-56.63,-47.73,-38.82,-29.88,-20.81,-53.51,-45.09,-36.51,-27.86, 8LK10860
 7-19.15,-10.41,-40.29,-32.38,-24.23,-15.89,-7.47,1.17,-25.74,-18.568LK10870
 8,-10.9,-2.96,5.14,13.54,-9.88,-3.58,3.41,10.88,18.6,26.64,7.34, 8LK10880
 912.46,18.68,25.57,32.85,40.42,25.89,29.54,34.63,41.04,47.82,54.09/8LK10890
 DATA AF/BLK10900
 A45.69,47.61,51.79,57.23,63.43,70.29,66.61,66.57,69.53,74.12,79.68,8LK10910
 B86.00,88.34,86.30,87.94,91.61,96.51,102.21/ 8LK10920
 DATA AG /-129.36,-124.60,-119.83,-115.03,-110.26, 8LK10930

00117 94* 1-105.55,-100.96.08,-91.37,-119.42,-114.92,-110.38,-105.79,-101BLK1
00117 95* 2-16,-96.51,-91.88,-87.21,-82.41,-107.45,-103.44,-99.26,-94.98, BLK10950
00117 96* 3-90.6,-86.19,-81.71,-77.23,-72.58,-92.77,-89.71,-86.23,-82.46,-78. BLK10960
00117 97* 447,-74.37,-70.19,-65.93,-61.48,-73.53,-72.8,-70.77,-67.93,-64.6,-68LK10970
00117 98* 51,-57.2,-53.28,-49.11,-41.28,-49.57,-51.87,-50.91,-48.74,-45.9, BLK10980
00117 99* 6-42.7,-39.24,-35.44,-39.18,-26.49,-30.41,-30.39,-28.88,-26.55,-BLK10990
00117 100* 723.74,-20.45,46.52,40.72,37.01,34.66,33.21,32.38,32.04,32.06,32.49BLK11000
00117 101* 8,88,56,79,51,72,99,68,32,65,01,62,69,61,11,60,10,59,63,126.40,117,8LK11010
00117 102* 980,109.21,103.80,98.33,95.10,91.88,90.11,88.34/ BLK11020
00121 103* DATA AH /-30.37,-29.64,-28.88,-27.72,-26.55,-25.15,-28LK11030
00121 104* 13.74,-22.17,-20.45,-23.33,-22.72,-21.84,-20.77,-19.57,-18.28LK11040
00121 105* 24,-16.82,-15.17,-16.47,-16.59,-16.27,-15.65,-14.8,-13.76,-12.58,-18LK11050
00121 106* 31.27,-9.88,-8.89,-9.51,-9.56,-9.23,-8.61,-7.75,-6.72,-5.57,-4.14, BLK11060
00121 107* 4-85,-2.07,-2.56,-2.55,-2.18,-1.55,-7.7,3,1.60,7.68,5.74,4.76,4.38BLK11070
00121 108* 51,45,4.85,5.5,6.34,7.34,16.7,13.93,12.37,11.57,11.3,11.45,11.88, BLK11080
00121 109* 612.53,13.52,26.21,22.50,20.28,19.02,18.39,18.24,18.43,18.89,19.70,8LK11090
00121 110* 736.36,31.44,28.52,26.72,25.70,25.22,25.15,25.40,25.89,46.52,40.72,8LK11100
00121 111* 837.01,34.66,32.21,32.38,32.04,32.06,32.49/ BLK11110
00123 112* DATA AI/95.17,80.15,65.54,53.23,44.02,37.38,32.55,28BLK11120
00123 113* 1.95,26.21,115.71,104.14,92.37,81.05,70.96,62.55,55.86,50.62,46.52,8LK11130
00123 114* 2132.56,123.21,113.55,103.98,94.83,86.45,79.09,72.87,67.54,147.68, BLK11140
00123 115* 3139.66,131.45,123.26,115.26,107.63,100.54,94.17,88.56,161.61,154.48LK11150
00123 116* 46,147.34,140.33,119.83,113.75,107.50,174.7,168.66,1628LK11160
00123 117* 5.62,156.58,150.54,144.50,138.46,132.42,126.38,177.4,161.6,143.4, BLK11170
00123 118* 6121.8,95.2,186.3,171.7,155.4,136.8,116.7,195.1,181.6,166.8,150.5, BLK11180
00123 119* 7132.6,204.0,191.4,177.9,163.3,147.7,212.9,201.2,188.7,175.5,161.6,8LK11190
00123 120* 8222.2,210.3,198.5,186.6,174.7,-30.41,-30.63,-30.67,-30.59,-30.39, BLK11200
00123 121* 9-22.50,-23.09,-23.6,-23.63,-13.86,-14.96,-15.7,-16.18/ BLK11210
00125 122* DATA AJ /-16.47,-4.37,-4.14,-7.4,-8.28,-8.89,6.14, BLK11220
00125 123* 13.46,1.54,1.16,-0.85,17.79,13.93,11.18,9.17,7.68,30.52,25.28,21.52, BLK11230
00125 124* 218.77,16.7,44.02,37.38,32.55,28.95,26.21/ BLK11240
00127 125* DATA AK /-26.48,-27.26,-27.92,-28.45,-28.92,-29.30, BLK11250
00127 126* 1-29.62,-29.88,-30.1,-30.28,-30.41,-21.02,-22.11,-23.0,-23.75,-24.38BLK11260
00127 127* 2-24.9,-25.36,-25.73,-26.06,-26.32,-26.46,-14.94,-16.45,-17.67,-18BLK11270
00127 128* 3-68,-19.53,-20.25,-20.85,-21.37,-21.81,-22.19,-22.5,-23.03,-10.16, BLK11280
00127 129* 4-11.84,-13.21,-14.34,-15.28,-16.09,-16.77,-17.35,-17.85,-18.18,-018LK11290
00127 130* 5-3.05,-5.37,-7.22,-8.72,-9.96,-11.01,-11.9,-12.66,-13.31,-13.86, BLK11300
00127 131* 69.41,5.12,1.87,-0.61,-2.6,-4.23,-5.58,-6.72,-7.69,-8.52,-9.12,20.71BLK11310
00127 132* 7,14.43,10.1,6.72,4.1,1.99,2.6,-1.19,-2.42,-3.47,-4.37,33.45,25.24,8LK11320
00127 133* 819.25,14.8,11.45,8.74,6.54,4.71,3.17,1.87,1.88,45.95,36.79,29.44, BLK11330
00127 134* 923.8,19.44,16.07,13.29,11.02,9.12,7.51,6.14,5.6,31.47,94.39,94/ BLK11340
00131 135* DATA AL / 33,38LK11350
00131 136* 15,28.09,23.89,20.51,17.76,15.44,13.49,11.96,66.66,58.21,50.23,43.18LK11360
00131 137* 24,37.17,32.25,28.21,24.89,22.11,19.78,17.79,74.56,67.32,59.73,52.68LK11370
00131 138* 32,46.26,40.81,36.2,32.35,29.11,26.37,24.15,82.45,75.41,68.34,61.5,8LK11380
00131 139* 455.11,49.35,44.34,40.03,36.35,33.21,30.52,88.81,82.65,76.12,69.66,8LK11390
00131 140* 563.44,57.66,52.40,47.78,43.74,40.24,37.27,95.17,89.16,83.15,77.23,8LK11400
00131 141* 671.38,65.54,60.61,55.69,51.39,47.70,44.02/ BLK11410
00133 142* DATA AM /104.94,98.01,90.23,81.37,71.12,59.16,45.59, BLK11420
00133 143* 131.88,20.95,113.25,107.27,100.76,93.63,85.67,76.79,66.95,56.39,45,8LK11430
00133 144* 295,120.40,115.79,110.19,104.17,97.75,90.73,83.18,75.10,66.66,127.68LK11440
00133 145* 30,123.62,118.65,113.4,107.84,102.07,95.85,89.29,82.45,134.75,130.48LK11450
00133 146* 42,126.09,121.76,116.44,111.12,105.81,100.49,95.17/ BLK11460
00135 147* DATA AN /65.16,51.82,-3.47,-10.85,-14.26,-16.57,-18.8LK11470
00135 148* 137,-19.82,-21.02,-22.04,-22.92,-23.69,-24.38,-24.99,-25.54,-26.04,8LK11480
00135 149* 2-26.48,74.13,67.69,57.36,39.09,5.99,-3.23,-7.63,-10.52,-12.65,-14.8LK11490
00135 150* 337,-15.78,-16.98,-18.0,-18.9,-19.69,-20.39,-21.02,83.09,77.17,70.3,8LK11500
00135 151* 461.77,50.17,31.98,12.48,3.55,-1.09,-4.43,-6.93,-8.9,-10.49,-11.86,8LK11510

@ FOR,* BLK1,BLK1 DATE 310871 PAGE 98

```

00135 152* 5-13.03.-14.04.-14.94.89.04.84.56.79.06.72.84.65.52.56.54.44.99.30.BLK11520
00135 153* 66.17.92.9.94.4.89.1.51.-1.24.-3.43.-5.22.-6.72.-8.03.94.98.90.77. BLK11530
00135 154* 786.16.81.07.75.42.69.01.61.59.52.84.42.58.31.64.22.32.15.46.10.57.BLK11540
00135 155* 86.94.4.28.1.95.01. 99.84.96.27.92.24.87.87.83.15.77.97.72.25.65.8.BLK11550
00135 156* 96.58.68.50.67.42.06.33.59.26.31.20.44.15.88.12.29.9.41.104.7/ BLK11560
00137 157* DATA A0/101.28.97.67.93.82.89.72.85.3.80.54.75.38.69.76.63.63.56.98.BLK11570
00137 158* 18.49.93.42.76.35.94.29.96.24.89.20.71.109.09.105.87.102.64.99.07. BLK11580
00137 159* 295.49.91.50.87.5.82.95.78.39.73.16.67.98.62.13.56.27.50.20.44.14. BLK11590
00137 160* 338.79.33.45.71.0.37.3.0.0.0.84.3.57.3.0.0.0.97.6.72.9.43.0.0.BLK11600
00137 161* 40.110.9.89.8.62.0.0.0.124.2.107.4.83.28.48.0.0.137.5.123.9.105.98.BLK11610
00137 162* 5.81.0.0.150.7.138.8.124.9.108.5.85.9.164.1.153.6.142.0.128.9.113.3.BLK11620
00137 163* 6177.4.167.9.158.0.147.0.134.8.78.8.62.3.45.4.0.0.0.89.8.78.3.61.0. BLK11630
00137 164* 741.9.29.1.98.8.90.1.78.9.60.1.27.8.106.7.99.5.91.1.80.6.65.2.114.0.BLK11640
00137 165* 8107.8.100.8.92.8.83.1.120.8.115.2.109.2.102.5.95.7/ BLK11650
00141 166* END BLK11660

```

END OF UNIVAC 1108 FORTRAN V COMPILATION. D *DIAGNOSTIC* MESSAGE(S)

BLK1 SYMBOLIC 01 MAR 71 18:49:05 0 01536576 14 166 (DELETED)
 @ HDG @ FOR,* BLK2,BLK2

@ FOR, * BLK2.BLK2
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:26:43

31 AUG 71

9:26:43.277

BLOCK DATA

STORAGE USED (BLOCK, NAME, LENGTH)

0003 SPHEAT 002432

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0003 R 000000 AA	0003 R 000152 AB	0003 R 000160 AC	0003 R 000332 AD	0003 R 000343 AE
0003 R 000515 AF	0003 R 000533 AG	0003 R 000651 AH	0003 R 001017 AI	0003 R 001171 AJ
0003 R 001215 AK	0003 R 001367 AL	0003 R 001375 AM	0003 R 001547 AN	0003 R 001560 AO
0003 R 001732 AP	0003 R 001750 AQ	0003 R 002066 AR	0003 R 002234 AS	0003 R 002406 AT
0000 I 000000 IS				

40

00100	1*	CD	*****	BLK20010
00100	2*	CD		BLK20020
00100	3*	CD	PROGRAMMER AND DATE	BLK20030
00100	4*	CD	NATIONAL BUREAU OF STANDARDS	BLK20040
00100	5*	CD	1967	BLK20050
00100	6*	CD		BLK20060
00100	7*	CD	DOCUMENTATION AND DATE	BLK20070
00100	8*	CD	J. I. PREWITT	BLK20080
00100	9*	CD	DECEMBER 1970	BLK20090
00100	10*	CD		BLK20100
00100	11*	CD	PURPOSE	BLK20110
00100	12*	CD	INITIALIZATION OF TABLES FOR USE BY PTHEAT (SPECIFIC	BLK20120
00100	13*	CD	HEAT FOR HYDROGEN).	BLK20130
00100	14*	CD		BLK20140
00100	15*	CD	USAGE	BLK20150
00100	16*	CD	BLOCK DATA	BLK20160
00100	17*	CD		BLK20170
00100	18*	CD	DESCRIPTION OF PARAMETERS	BLK20180
00100	19*	CD		BLK20190
00100	20*	CD	INPUT	BLK20200
00100	21*	CD	NONE	BLK20210
00100	22*	CD		BLK20220
00100	23*	CD		BLK20230
00100	24*	CD	OUTPUT	BLK20240
00100	25*	CD	COMMON	BLK20250
00100	26*	CD	UNKNOWN	BLK20260
00100	27*	CD		BLK20270
00100	28*	CD	REMARKS AND RESTRICTIONS	BLK20280
00100	29*	CD	THIS ROUTINE IS LOADED INTO CORE EVERY TIME PTHEAT IS	BLK20290
00100	30*	CD	LOADED INTO CORE.	BLK20300
00100	31*	CD	THIS ROUTINE WAS OBTAINED FROM NASA/MSC.	BLK20310
00100	32*	CD		BLK20320
00100	33*	CD	SUBPROGRAMS REQUIRED	BLK20330
00100	34*	CD	NONE	BLK20340

00117 93* 73.003,3.097,1.71,3.284,3.378/ BLK21000
00121 94* DATA AM / 25.22,30.03,35.61,40.25,44.37,48.45,24.47,8LK20940
00121 95* 130.12,36.70,42.16,47.08,51.94,22.95,29.45,36.95,43.16,48.74,54.28,8LK20950
00121 96* 220.18,27.65,36.20,43.19,49.41,55.58,16.12,24.74,34.50,42.30,49.15,8LK20960
00121 97* 355.90,10.33,20.63,31.93,40.59,48.07,55.40,1.49,4.15,13.28,59.38,11,8LK20970
00121 98* 446.15,53.98,-19.29,10.62,24.91,35.04,43.50,51.78,00.00, 8.28,17.76,8LK20980
00121 99* 530.56,39.53,48.33, 0.,-55.0, 4.28,17.23,31.90,42.56, 0., 0.,8LK20990
00121 100* 6-9.11, 3.79,17.00,32.36,11.93,-5.256,1.590, 0., 0.11,16.88,15.48,8LK21000
00121 101* 711.00,4.18,-13.56, 0., 0.,23.81,18.76,13.42,-1.68,-17.82, 0.,8LK21010
00121 102* 831.05,25.95,27.70,16.41,3.20,-10.31,38.05,32.90,33.42,32.03,20.87,8LK21020
00121 103* 9 9.05,44.95,39.75,39.57,39.66,34.95,24.46/ 8LK21030
00123 104* DATA AI / 1027.1143.1238.1311.1362.1407.1445.8LK21040
00123 105* 1962.3,1099.1202.1285.1344.1394.1438. 869.1026.1142.1235.8LK21050
00123 106* 21301.1357.1405.1727.5.906.9.1040.1145.1219.1282.1335.533.3.8LK21060
00123 107* 3742.1.895.5.1016.1099.1170.1230.333.8.512.8.696.3.838.4.934.9.8LK21070
00123 108* 41015.1083. 91.2.290.2.434.2.603.4.720.3.814.5.893.8. 0., 0.,8LK21080
00123 109* 5153.4.302.5.433.2.558.1.653.3.343.4. 72.4.-162. 20.0.151.5.276.4.8LK21090
00123 110* 6378.8.929.7.692.1.477.8.288.3.134.0. 90.2.-120.1489.1269.1082.8LK21100
00123 111* 7907.6.759.5.607.4.444.7.2037.1817.1634.1469.1331.1195.1053.8LK21110
00123 112* 82584.2363.2180.2016.1881.1751.1620.3135.2911.2726.2563.8LK21120
00123 113* 92428.2299.2173.1.566.1.557.1.780.1.770.2.059.2.037.2.377.2.333/8LK21130
00125 114* DATA AJ / 2.926,2.724,1.091,3.210,2.460,5.286,2.456,8LK21140
00125 115* 13.245,2.428,3.431,2.434,3.025,2.461,2.813,2.463,2.700,2.465,2.638,8LK21150
00125 116* 22.470,2.612/ 8LK21160
00127 117* DATA AK / 2.819,2.811,2.809,2.809,2.808,2.808,2.808,8LK21170
00127 118* 13.032,2.963,2.950,2.944,2.940,2.938,2.936,3.624,3.255,3.186,3.155,8LK21180
00127 119* 23.136,3.124,3.114,5.313,3.972,3.717,3.604,3.537,3.491,3.457,9.333,8LK21190
00127 120* 35.610,4.898,4.582,4.394,4.265,4.170,17.15,8.823,7.203,6.481,6.049,8LK21200
00127 121* 45.754,5.536,29.47,14.22,11.11,9.705,8.862,8.284,7.855,2.808,2.807,8LK21210
00127 122* 52.807,2.938,2.931,2.928,3.124,3.086,3.070,3.492,3.353,3.296,4.268,8LK21220
00127 123* 63.878,3.719,5.762,4.865,4.498,8.300,6.533,5.809,2.807,2.807,2.806,8LK21230
00127 124* 72.806,2.806,2.806,2.931,2.925,2.923,2.922,2.921,2.920,3.085,3.055,8LK21240
00127 125* 83.044,3.039,3.036,3.034,3.353,3.239,3.199,3.181,3.170,3.189,3.879,8LK21250
00127 126* 93.559,3.446,3.395,3.365,3.345,4.867,4.129,3.867,3.751,3.682,3.720/8LK21260
00131 127* DATA AL/8LK21270
00131 128* 16.541,5.077,4.557,4.327,4.189,4.095/ 8LK21280
00133 129* DATA AM / 2.806,2.806,2.805,2.804,2.803,3.034,3.029,8LK21290
00133 130* 13.026,3.024,3.022,3.345,3.294,3.271,3.257,3.247,4.095,3.861,3.757,8LK21300
00133 131* 23.694,3.652,2.485,2.509,2.519,2.520,2.639,2.637,2.807,2.803,2.884,8LK21310
00133 132* 32.976,3.078,3.134,2.728,2.802,2.860,2.900,2.578,2.626,2.663,2.689,8LK21320
00133 133* 42.506,2.538,2.562,2.578,2.482,2.504,2.520,2.530,2.480,2.489,2.500,8LK21330
00133 134* 52.509,1.602,1.634,1.665,1.682,1.694,1.706,1.758,1.800,1.838,1.876,8LK21340
00133 135* 61.893,1.911,1.929,1.947,1.961,2.005,2.046,2.084,2.215,2.216,2.217,8LK21350
00133 136* 72.219,2.229,2.238,2.271,2.304,2.338,2.533,2.543,2.552,2.560,2.571,8LK21360
00133 137* 82.580,2.617,2.653,2.684,2.759,2.776,2.791,2.806,2.820,2.833,2.882,8LK21370
00133 138* 92.920,2.951,2.892,2.910,2.926,2.943,2.958,2.972,3.023,3.062,3.093/8LK21380
00135 139* DATA AN / 2.940,2.956,2.973,2.989,3.003,3.015,3.063,3.101,3.134/ 8LK21390
00137 140* DATA AO / 1.113,1.083,1.060,1.050,1.353,1.335,1.325,8LK21400
00137 141* 11.312,1.496,1.498,1.494,1.491,1.572,1.571,1.601,1.603,1.595,1.630,8LK21410
00137 142* 21.655,1.672,1.617,1.662,1.696,1.724,1.651,1.699,1.738,1.771,1.693,8LK21420
00137 143* 31.741,1.782,1.819,1.757,1.807,1.850,1.888,1.173,1.171,1.168,1.165,8LK21430
00137 144* 41.160,1.156,1.149,1.1345,1.1341,1.1340,1.1338,1.1334,1.1332,1.1329,1.456,8LK21440
00137 145* 51.455,1.454,1.453,1.452,1.450,1.449,1.517,1.519,1.521,1.523,1.525,8LK21450
00137 146* 61.526,1.527,1.551,1.552,1.556,1.561,1.564,1.569,1.572,1.583,1.571,8LK21460
00137 147* 71.571,1.575,1.581,1.587,1.591,1.610,1.591,1.584,1.584,1.589,1.594,8LK21470
00137 148* 81.600,1.610,1.610,1.608,1.608,1.610,1.615,1.621,1.616,1.623,1.627,8LK21480
00137 149* 91.632,1.635,1.641,1.646,1.632,1.640,1.646,1.653,1.659,1.665,1.671/8LK21490
00141 150* DATA AP /1.665,1.673,1.680,1.687,1.693,1.700,1.707,8LK21500

00141 151° 11.715,1.723,1.731,1.738,1.744,1.751,1.757/ BLK21510
 00143 152° DATA AQ / 1.583,1.571,1.571,1.575,1.597,1.578,1.574,BLK21520
 00143 153° 11.579,1.608,1.587,1.581,1.582,1.610,1.596,1.589,1.589,1.610,1.604,BLK21530
 00143 154° 21.598,1.598,1.610,1.610,1.608,1.608,1.485,1.511,1.534,1.557,1.577,BLK21540
 00143 155° 31.604,1.621,1.621,1.610,1.495,1.516,1.534,1.552,1.569,1.583,1.596,BLK21550
 00143 156° 41.606,1.610,1.516,1.532,1.548,1.563,1.577,1.591,1.602,1.610,1.616,BLK21560
 00143 157° 51.549,1.562,1.574,1.585,1.597,1.608,1.619,1.627,1.632,1.595,1.606,BLK21570
 00143 158° 61.615,1.625,1.634,1.642,1.652,1.660,1.665,1.656,1.664,1.671,1.679,BLK21580
 00143 159° 71.686,1.693,1.701,1.708,1.715/ BLK21590
 00145 160° DATA AR / 1.131,1.132,1.133,1.133,1.133,1.131,1.240,BLK21600
 00145 161° 11.239,1.238,1.237,1.236,1.235,1.342,1.338,1.335,1.332,1.330,1.328,BLK21610
 00145 162° 21.417,1.412,1.409,1.406,1.404,1.402,1.464,1.462,1.460,1.459,1.457,BLK21620
 00145 163° 31.456,1.501,1.497,1.495,1.495,1.495,1.495,1.565,1.535,1.523,1.520,BLK21630
 00145 164° 41.520,1.522,1.754,1.780,1.544,1.546,1.541,1.541,1.943,2.300,1.710,BLK21640
 00145 165° 51.585,1.564,1.557, 0.,2.400,1.808,1.653,1.594,1.573, 0., 0.,BLK21650
 00145 166° 61.620,1.683,1.624,1.591,1.583,2.300,3.100, 0.,1.632,1.608,1.330,BLK21660
 00145 167° 71.976,2.608,1.560, 0., 0.,1.522,1.660,1.736,1.617,1.495, 0.,BLK21670
 00145 168° 81.527,1.589,1.679,1.663,1.609,1.560,1.522,1.663,1.608,1.648,1.627,BLK21680
 00145 169° 91.601,1.520,1.551,1.579,1.613,1.622,1.609/ BLK21690
 00147 170° DATA AS / 1.151,1.152,1.152,1.152,1.153,1.153,1.153,BLK21700
 00147 171° 11.243,1.242,1.241,1.241,1.240,1.240,1.240,1.327,1.326,1.325,1.324,BLK21710
 00147 172° 21.323,1.322,1.321,1.393,1.392,1.391,1.390,1.389,1.388,1.387,1.440,BLK21720
 00147 173° 31.439,1.438,1.438,1.437,1.436,1.436,1.478,1.474,1.473,1.472,1.471,BLK21730
 00147 174° 41.471,1.470,1.508,1.503,1.506,1.504,1.501,1.500,1.498, 0., 0.,BLK21740
 00147 175° 51.547,1.546,1.548,1.539,1.533,1.646,1.780,1.938,1.602,1.615,1.628,BLK21750
 00147 176° 61.641,1.544,1.607,1.690,1.805,1.978,2.346,2.652,1.517,1.544,1.578,BLK21760
 00147 177° 71.623,1.687,1.787,1.962,1.504,1.518,1.534,1.551,1.570,1.592,1.618,BLK21770
 00147 178° 81.498,1.508,1.517,1.526,1.536,1.546,1.556,1.499,1.506,1.512,1.519,BLK21780
 00147 179° 91.526,1.532,1.539,1.129,1.130,1.220,1.220,1.310,1.307,1.380,1.378,BLK21790
 00151 180° DATA AT / 1.432,1.430,1.477,1.469,1.477,1.700,1.475,BLK21800
 00151 181° 11.671,1.476,1.619,1.477,1.544,1.478,1.517,1.478,1.504,1.481,1.498,BLK21810
 00151 182° 21.485,1.499/ BLK21820
 00153 183° END BLK21830

END OF UNIVAC 1108 FORTRAN V COMPILATION.

D *DIAGNOSTIC* MESSAGE(S)

BLK2	CODE	SYMBOLIC	RELOCATABLE	01 MAR 71	18:49:07	0	01543222	14	183	(DELETED)
BLK2				19 MAY 71	02:49:41	1	01524500	24	1	(DELETED)
						0	01524530	14	117	

FOR,• BPROPG,BPROPG

@ FOR, * BPROPG, BPROPG
 UNIVAC 1108 FORTRAN V LEVEL 2204 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:26:45

31 AUG 71

9:26:45.152

SUBROUTINE BPROPG ENTRY POINT 000146

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000212
 0000 *DATA 000166
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 BETA
 0004 HPTCP
 0005 HPTV
 0006 HPTTC
 0007 OPTV
 0010 OPTTC
 0011 NERR2\$
 0012 NERR3\$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000012	10L	0001	000067	20L	0003 R	000000	BETA	0000 R	000147	DTS	0000 R	000074	FCPO
0000 R	000000	FRH	0000 R	000050	FSVO	0004 R	000000	HPTCP	0006 R	000000	HPTTC	0005 R	000000	HPTV
0000 I	000144	IS	0000 I	000145	NPH	0000 I	000146	NPO	0010 R	000000	OPTTC	0007 R	000000	OPTV
0000 R	000024	PH	0000 R	000120	PO									

00101 1* SUBROUTINE BPROPG (IFLUID, PX, TSAT, SV, MU, K, CP, PR)
 00103 2* REAL MU, K
 00103 3* C
 00103 4* C OBTAIN SATURATED GAS PROPERTIES AT INPUT PX
 00103 5* C BY LINEAR INTERPOLATION OF FUNCTION-PRESSURE TABLES
 00103 6* C
 00104 7* DIMENSION FRH(20), PH(20), FSVO(20), FCPO(20), PO(20)
 00105 8* DATA FRH / .0592, .0837, .1108, .1612, .2119, .2633, .3160,
 00105 9* 1 .3703, .4264, .4848, .5456, .942, 8*0. /
 00107 10* DATA NPH / 12/, PH / 10., 14.696, 20., 30., 40., 50., 60., 70.,
 00107 11* 1 80., 90., 100., 150., 8*0. /
 00112 12* DATA FSVO / 1.2396, 1.0144, .83781, .69771, .58529, .49415,
 00112 13* 1 .41954, .35792, .30658, .26347, .22697, .19582, .16902, .14575,
 00112 14* 2 .12531, .10711, .09051, .07465, .05852, .03675 /
 00114 15* DATA FCPO / .249, .255, .262, .270, .280, .291, .304, .318, .336,
 00114 16* 1 .357, .383, .416, .457, .514, .594, .719, .945, 1.497, 3.631, 99. /
 00116 17* DATA NPO / 20/, PO / 46.261, 57.286, 70.163, 85.040, 102.09,
 00116 18* 1 121.51, 143.49, 168.20, 195.82, 226.59, 260.66, 298.26, 339.62,
 00116 19* 2 384.96, 434.55, 488.66, 547.69, 612.08, 653.06, 737.06 /
 00116 20* C

@ FOR,* BPROPG,BPROPG

DATE 310871 PAGE 104

```

00121 21*      DTS = .5
00122 22*      GO TO (10,20),IFLUID
00123 23*      10 SV = 1728. / BETA ( FRH, PH, PX, NPH )
00124 24*      CP = HPTCP ( PX, TSAT+DTS )
00125 25*      MU = HPTV ( PX, TSAT+DTS ) * 32.2 * 3600. / 12.
00126 26*      K = HPTTC ( PX, TSAT+DTS ) / 3600. / 12.
00127 27*      PR = CP * MU / K
00130 28*      RETURN
00131 29*      20 SV = BETA ( FSVO, PO, PX, NPO ) * 1728.
00132 30*      CP = BETA ( FCPO, PO, PX, NPO )
00133 31*      MU = OPTV ( PX, TSAT+DTS ) * 32.2 * 3600. / 12.
00134 32*      K = OPTTC ( PX, TSAT+DTS ) / 3600. / 12.
00135 33*      PR = CP * MU / K
00136 34*      RETURN
00137 35*      END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

BPROPG SYMBOLIC

14 JUN 71 15:04:56 0 01606314 14 35 (DELETED)

BPROPG CODE RELOCATABLE

14 JUN 71 15:04:56 1 01607266 24 1 (DELETED)

0 01607316 14 25

@ HDG @ FOR,* BPROPL,BPROPL

31 AUG 71

9:26:46.405

R FOR, BPROPL,BPROPL
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09126:46

SUBROUTINE BPROPL ENTRY POINT 000146

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000212
0000	*DATA	000166
0002	*BLANK	000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003	BETA
0004	HPTCP
0005	HPTV
0006	HPTTC
0007	OPTV
0010	OPTTC
0011	NERR25
0012	NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000012	10L	0001	000067	20L	0003	R	000000	BETA	0000	R	000147	DTS	0000	R	000074	FCPO		
0000	R	000000	FRH	0000	R	000050	FSVO	0004	R	000000	HPTCP	0006	R	000000	HPTTC	0005	R	000000	HPTV
0000	I	000144	IS	0000	I	000145	NPH	0000	I	000146	NPO	0010	R	000000	OPTTC	0007	R	000000	OPTV
0000	R	000024	PH	0000	R	000120	PO												

00101 1* SUBROUTINE BPROPL (IFLUID, PX, TSAT, SV, MU, K, CP, PR)
 00103 2* REAL MU, K
 00103 3* C
 00103 4* C OBTAIN SATURATED LIQUID PROPERTIES AT INPUT PX
 00103 5* C BY LINEAR INTERPOLATION OF FUNCTION-PRESSURE TABLES
 00103 6* C
 00104 7* DIMENSION FRH(20), PH(20), FSVO(20), FCPO(20), PO(20)
 00105 8* DATA FRH / 4.5025, 4.418, 4.3384, 4.2123, 4.1034, 4.0032, 3.9078,
 00105 9* 1 3.8168, 3.7272, 3.6377, 3.5486, 2.99 ,8*0./
 00107 10* DATA NPH /12/, PH / 10., 14.696, 20., 30., 40., 50., 60., 70.,
 00107 11* 1 80., 90., 100., 50. ,8*0./
 00112 12* DATA FSVO / .01489, .01510, .01533, .01557, .01582, .01609,
 00112 13* 1 .01639, .01670, .01704, .01742, .01783, .01830, .01882, .01943,
 00112 14* 2 .02014, .02101, .02213, .02371, .02645, .03675 /
 00114 15* DATA FCPO / .417, .421, .426, .431, .438, .446, .455, .466,
 00114 16* 1 .479, .495, .515, .548, .577, .624, .689, .787, .962, 1.335,
 00114 17* 2 2.791, 100. /
 00116 18* DATA NPO /20/, PO / 46.261, 57.286, 70.163, 85.040, 102.09,
 00116 19* 1 121.51, 143.49, 168.20, 195.82, 226.59, 260.66, 298.26, 339.62,
 00116 20* 2 384.96, 434.55, 488.66, 547.69, 612.08, 653.06, 737.06 /

6 FOR,* BPROPL,BPROPL

DATE 310871 PAGE 106

```

00116 21* C
00121 22*   DTS = .5
00122 23*   GO TO (10,20),IFLUID
00123 24* 10 SV = 1728. / BETA ( FRH, PH, PX, NPH )
00124 25*   CP = HPTCP ( PX, TSAT-DTS )
00125 26*   MU = HPTV ( PX, TSAT-DTS ) * 32.2 * 3600. / 12.
00126 27*   K = HPTTC ( PX, TSAT-DTS ) / 3600. / 12.
00127 28*   PR = CP * MU / K
00130 29*   RETURN
00131 30* 20 SV = BETA ( FSV0, PO, PX, NPO ) * 1728.
00132 31*   CP = BETA ( FCPO, PO, PX, NPO )
00133 32*   MU = OPTV ( PX, TSAT-DTS ) * 32.2 * 3600. / 12.
00134 33*   K = OPTTC ( PX, TSAT-DTS ) / 3600. / 12.
00135 34*   PR = CP * MU / K
00136 35*   RETURN
00137 36*   END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

BPROPL SYMBOLIC
BPROPL CODE RELOCATABLE

14 JUN 71	15:04:55	0	01604536	14	36	(DELETED)
14 JUN 71	15:04:55	1	01605526	24	1	(DELETED)
		0	01605556	14	25	

@ HDG @ FOR,* CDDATA,CDDATA

FOR, * CDDATA, CDDATA
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:26:47

31 AUG 71

9:26:47.458

SUBROUTINE CDDATA ENTRY POINT 001774

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	002005
0000	*DATA	000302
0002	*BLANK	000160
0003	STAB	000504

EXTERNAL REFERENCES (BLOCK, NAME)

0004	BCDINT
0005	SQZB
0006	PACK
0007	NRDUS
0010	N101S
0011	N102S
0012	NWDUS
0013	NERR2S
0014	NEXP9S
0015	NERR3S

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000	000204	100F	0000	000206	110F	0001	000060	120L	0001	000067	130L	0001	000103	140L
0001	000014	144G	0001	000021	150G	0001	000167	156L	0001	000213	159L	0001	000035	160G
0001	000265	160L	0001	000045	164G	0001	000272	165L	0001	000302	180L	0001	000304	190L
0001	000307	200L	0001	000312	220L	0001	000135	223G	0001	000144	227G	0001	000157	236G
0001	000356	250L	0001	000364	260L	0001	000402	270L	0001	000405	280L	0001	000416	290L
0001	000417	300L	0001	000422	310L	0001	000346	312G	0001	000443	320L	0001	000460	330L
0001	000467	340L	0001	000427	346G	0001	000527	350L	0001	000552	360L	0001	000555	370L
0001	000576	380L	0001	000615	390L	0001	000626	400L	0001	000635	420L	0001	000646	450L
0001	000650	460L	0001	000703	462L	0001	000731	466L	0001	000751	470L	0001	000711	472G
0001	001031	485L	0001	001055	500L	0001	001061	510L	0001	001074	520L	0001	001106	530L
0001	001045	534G	0001	001115	540L	0001	001120	550L	0001	001121	552L	0001	001124	553L
0001	001174	558L	0001	001177	570L	0001	001216	580L	0001	001235	590L	0001	001244	600L
0001	001253	610L	0001	001271	620L	0001	001256	627G	0001	001311	630L	0001	001317	640L
0001	001322	650L	0001	001331	660L	0001	001405	664L	0001	001413	666L	0001	001443	670L
0001	001453	680L	0001	001456	690L	0001	001506	700L	0001	001547	720L	0001	001520	722G
0001	001562	740L	0001	001556	742G	0001	001577	750L	0001	001616	760L	0001	001627	770L
0001	001646	776L	0001	001651	780L	0001	001705	790L	0001	001710	800L	0001	001712	810L
0001	001717	820L	0001	001723	830L	0001	001727	840L	0001	001732	850L	0001	001734	860L
0000	000211	870F	0001	001752	880L	0001	001754	890L	0000	R 000226	AX	0000	I 000001	BCDTBL
0000	D 000223	DP	0000	I 000150	I	0003	I 000002	IADD	0000	I 000243	IAPTST	0000	I 000161	IBCD5
0000	I 000146	IBEG	0000	I 000230	IBTST	0000	I 000227	ICHTRS	0000	I 000013	ICOM	0003	I 000000	ICOUNT
0000	I 000227	ICTST	0000	I 000223	IDP	0000	I 000162	IDTEST	0000	I 000237	IDTST	0000	I 000152	IEND
0000	I 000231	IEG	0000	I 000233	IETST	0000	I 000173	IEXP	0000	I 000203	IFLAG	0000	I 000153	IH
0000	I 000200	IIDP	0000	I 000201	IJK	0000	I 000244	ILO	0000	I 000240	ILPAR	0000	I 000234	IMINTS
0000	I 000163	IMINUS	0000	I 000000	INT	0000	I 000154	IO	0000	I 000144	IOCTM	0000	I 000156	IPER

S FOR,* CDDATA,CDDATA

DATE 310871 PAGE 108

0000 I 000235 IPLTS	0000 I 000236 IPTST	0000 I 000174 IPTSH	0000 I 000241 IREP	0000 I 000245 IRPAR
0000 I 000157 ISEP	0000 I 000123 ISEQ	0000 I 000225 ISP	0000 I 000232 ISTR	0000 I 000242 ISTST
0003 I 000000 ITYPE	0000 I 000226 IX	0000 I 000147 IS	0000 I 000151 J	0002 I 000000 JIN
0002 I 000001 JOUT	0002 I 000002 KOUT	0002 I 000003 KRBF	0003 I 000004 KSYMB	0000 I 000143 L
0003 I 000003 LADD	0000 I 000141 LE	0000 I 000171 LI	0000 I 000202 LL	0000 I 000164 MINUSX
0000 I 000165 N	0000 I 000160 NADR	0000 I 000125 NAME	0000 I 000172 NC	0000 I 000167 NCOL
0000 I 000145 NDCAS	0000 I 000175 NDECL	0000 I 000176 NDECR	0000 I 000155 NGP	0000 I 000166 NN
0000 I 000170 NR	0000 R 000225 SP	0000 R 000177 XX		

```

00101 10 SUBROUTINE CDDATA
00101 20 C.....
00101 30 C.....CDDATA IS A VARIABLE FORMAT CARD INPUT ROUTINE WHICH WILL-
00101 40 C.....(1) READ A CARD,
00101 50 C.....(2) PRINT THE CARD IMAGE,
00101 60 C.....(3) PROCESS THE DATA FIELDS AS NECESSARY AND STORE THE PROCESSED
00101 70 C..... DATA IN A BUFFER (KRBF).
00101 80 C.....
00103 90 INTEGER
00103 100 * BCDTBL
00103 110 C.....
00104 120 DOUBLE PRECISION
00104 130 * DP
00104 140 C.....
00105 150 DIMENSION
00105 160 * ICOM(72) ,ISEQ(2)
00105 170 * ,NAME(12) ,BCDTBL(10)
00105 180 * ,IDP(2) ,LE(2)
00105 190 * ,ICHTRS(15)
00105 200 C.....
00105 210 C.....KRBF IS THE DATA STORAGE BUFFER
00106 220 COMMON JIN,JOUT,KOUT,KRBF(109)
00106 230 C.....
00106 240 C.....THE FOLLOWING COMMON BLOCK CONTAINS THE INPUT TABLE OF VARIABLE
00106 250 C.....NAMES AND STORAGE ADDRESSES.
00106 260 C
00106 270 C * * * * *
00106 280 C *
00106 290 C * INSERT PROGRAM SYMBOL COMMON BLOCK
00106 300 C *
00106 310 C COMMON /STAB/ ICOUNT, ITYPE, IADD, LADD, KSYMB( )
00107 320 COMMON /STAB/ ICOUNT, ITYPE, IADD, LADD, KSYMB( 320)
00107 330 C *
00107 340 C * * * * *
00107 350 C
00107 360 C.....
00107 370 C.....ICOUNT IS THE NUMBER OF VARIABLE NAMES (OR LOCATIONS ALLOTTED FOR
00107 380 C.....NAMES) IN THE SYMBOL TABLE (KSYMB).
00107 390 C.....KSYMB IS DIVIDED IN 2 EQUAL SECTIONS. THE FIRST HALF CONTAINS THE
00107 400 C.....BCD EQUIVALENT OF THE VARIABLE NAME. THE SECOND HALF CONTAINS THE
00107 410 C.....OCTAL STORAGE ADDRESSES OF THE VARIABLES.
00110 420 EQUIVALENCE
00110 430 * (DP ,IDP(1)) , (SP ,ISP)
00110 440 * ,(IX ,AX)
00110 450 * ,(ICHTRS(1) ,ICTST) ,(ICHTRS(2) ,IBTST)
00110 460 * ,(ICHTRS(3) ,IEW) ,(ICHTRS(4) ,ISTR)

```

```

00110 47*  *,(ICHTRS(5),IST)      ,(ICHTRS(6),IMINTS)
00110 48*  *,(ICHTRS(7),IPLTS)    ,(ICHTRS(8),IPTST)
00110 49*  *,(ICHTRS(9),IOTST)    ,(ICHTRS(10),ILPAR)
00110 50*  *,(ICHTRS(11),IREP)     ,(ICHTRS(12),ISTST)
00110 51*  *,(ICHTRS(13),IAPTST)  ,(ICHTRS(14),ILO)
00110 52*  *,(ICHTRS(15),IRPAR)
00110 53*  C.....
00111 54*  DATA      (BCDTBL(L),L=1,10) /
00111 55*  * ,IH0      ,IH1      ,IH2      ,IH3      ,IH4
00111 56*  * ,IH5      ,IH6      ,IH7      ,IH8      ,IH9      /
00113 57*  DATA
00113 58*  * ,ICTST / IH,      /      ,IBTST / IH      /
00113 59*  * ,IEQ / IH=      /      ,ISTR / IH=      /
00113 60*  * ,IETST / IHE      /      ,IMINTS / IH=      /
00113 61*  * ,IPLTS / IH+      /      ,IPTST / IH=      /
00113 62*  * ,IOTST / IHU      /      ,ILPAR / IH(      /
00113 63*  * ,IRPAR / IH)      /      ,ISTST / IH/      /
00113 64*  * ,IAPTST / IH'      /      ,ILO / IH0      /
00113 65*  * ,IREP / 6HR      /      ,IOCTM / 040000000000 /
00113 66*  * ,NDCAS / 6HENDCAS /      ,IBEG / 6HBEGIN /
00113 67*  * ,LE(1) / 38      /      ,LE(2) / 308      /
00113 68*  C.....
00113 69*  C.....ADJUST MAXIMUM EXPONENT OF DOUBLE PRECISION VALUE IF ON 7094
00140 70*  IF (IBTST.LT.0) LE(2) = LE(1)

00140 71*  C.....
00140 72*  C.....READ IN CARD IMAGE
00142 73*  READ (JIN,100)ICOM,ISEQ
00154 74*  100 FORMAT(72A1,A6,A2)
00154 75*  C.....
00154 76*  C.....WRITE OUT CARD IMAGE
00155 77*  IF (JOUT.NE.0) WRITE (JOUT,110) (ICOM(L),L=1,72), (ISEQ(L),L=1,2)
00170 78*  110 FORMAT(15X72A1,10XA6,A2)
00170 79*  C.....
00171 80*  I = 1
00172 81*  J = 1
00173 82*  IEND = 0
00173 83*  C.....
00173 84*  C.....SKIP AROUND ALL BLANKS (IBTST)
00174 85*  120 IF (ICOM(I).NE.IBTST) GO TO 140
00176 86*  130 IF (IEND.EQ.1) GO TO 880
00200 87*  I = I+1
00201 88*  IF (I.GT.72) GO TO 880
00203 89*  GO TO 120
00203 90*  C.....
00204 91*  140 IF (ICOM(I).EQ.ICTST) GO TO 130
00206 92*  IF (ICOM(I).EQ.ISTR) GO TO 880
00210 93*  IH = 0
00211 94*  IO = 0
00212 95*  NGP = 0
00213 96*  IPER = 0
00214 97*  ISEP = 0
00215 98*  NADR = 0
00216 99*  IBCDS = 0
00217 100*  IOTEST = 0
00220 101*  IMINUS = 0
00221 102*  MINUSX = 0
00221 103*  C.....
00221 104*  C.....BEGIN SCAN OF FIELD

```

```

00222 105* DO 460 N=1,72
00225 106* NN = N
00225 107* C.....CHECKING FOR A DIGIT 0-9
00226 108* DO 150 L=1,10
00231 109* IF (ICOM(N).EQ.HCDTBL(L)) GO TO 460
00233 110* 150 CONTINUE
00233 111* C.....
00233 112* C.....LOOK FOR KEY CHARACTERS
00235 113* DO 153 L=1,14
00240 114* IF (ICOM(N).EQ.ICHTRS(L)) GO TO 156
00242 115* 153 CONTINUE
00244 116* GO TO 450
00245 117* 156 GO TO (420,460,220,200,380,165,160,390,370,280,159,270,462,400),L
00245 118* C.....
00245 119* C.....FOUND AN R, CHECK FOR REPEAT GROUP
00246 120* 159 IF(N.EQ.1) GO TO 450
00250 121* IF (IH.EQ.1) GO TO 460
00252 122* IF (IO.EQ.1) GO TO 450
00254 123* NCOL = N - I
00255 124* CALL BCDINT (ICOM(I), NR, NCOL)
00256 125* IF (NCOL.LT.0) GO TO 810
00260 126* KRBF(J) = 43
00261 127* KRBF(J+1) = NR
00262 128* J = J+2
00263 129* I = N
00264 130* GO TO 130
00264 131* C.....
00264 132* C.....TEST FOR SIGN OF NUMBER (N=1) OR SIGN OF EXPONENT (N.GT.1)
00265 133* 160 IF (N=1) 860,460,190
00270 134* 165 IF (N=1) 860,170,180
00273 135* 170 IMINUS = 1
00274 136* GO TO 460
00275 137* 180 MINUSX = 1
00276 138* 190 NGP = 2
00277 139* GO TO 550
00277 140* C.....
00277 141* C.....FOUND AN ASTERISK (END OF RECORD)
00300 142* 200 IEND = 1
00301 143* GO TO 420
00301 144* C.....
00301 145* C.....HAVE JUST FOUND A SYMBOL
00302 146* 220 NCOL = N-I
00303 147* IF (NCOL.EQ.0) GO TO 130
00305 148* CALL SQZB(ICOM(I),NCOL)
00306 149* IF (NCOL.EQ.0) GO TO 130
00310 150* CALL PACK(ICOM(I), NAME, NCOL)
00310 151* C.....
00310 152* C.....THE CURRENT FIELD IS A SYMBOL (6 CHARACTERS OR LESS)
00311 153* 230 DO 240 L=1,ICOUNT
00314 154* IF (NAME(L).EQ.KSYMB(L)) GO TO 250
00316 155* 240 CONTINUE
00320 156* GO TO 260
00320 157* C.....
00321 158* 250 L = L+ICOUNT
00322 159* NADR = KSYMB(L)
00323 160* 260 KRBF(J) = 1
00324 161* KRBF(J+1) = NAME(1)
00325 162* KRBF(J+2) = NAOR

```

```

00326 163*      J = J+3
00327 164*      IF (IBCOS.EQ.1) GO TO 290
00331 165*      GO TO 790
00331 166*      C.....
00331 167*      C.....DIMENSION GROUP
00332 168*      270 NGP = 20
00333 169*      GO TO 300
00333 170*      C.....
00333 171*      C.....SUBSCRIPT GROUP
00334 172*      280 NGP = 30
00335 173*      IF (IH,NE.1) GO TO 290
00337 174*      IBCOS = 1
00340 175*      GO TO 220
00341 176*      290 IBCOS = 0
00342 177*      300 LI = N
00343 178*      NCOL = 0
00344 179*      310 LI = LI+1
00345 180*      DO 320 L=1,10
00350 181*      IF (ICOM(LI).NE.BCDTBL(LI)) GO TO 320
00352 182*      NCOL = NCOL+1
00353 183*      GO TO 310
00354 184*      320 CONTINUE
00356 185*      IF (ICOM(LI).NE.IBTST) GO TO 330
00360 186*      NCOL = NCOL+1
00361 187*      GO TO 310
00361 188*      C.....
00362 189*      330 IF (ICOM(LI).NE.ICTST) GO TO 350
00364 190*      340 CALL BCDINT (ICOM(NN+1), INT, NCOL)
00365 191*      IF (NCOL.LT.0) GO TO 820
00367 192*      KRBF(J) = NGP+3
00370 193*      KRBF(J+1) = INT
00371 194*      J = J+2
00372 195*      NCOL = 0
00373 196*      I = LI
00374 197*      NN = LI
00375 198*      IF (ISEP.EQ.1) GO TO 130
00377 199*      GO TO 310
00377 200*      C.....
00400 201*      350 IF (ICOM(LI).EQ.1STST) IF (NGP-20) 840,360,840
00404 202*      IF (ICOM(LI).NE.IRPAR) GO TO 840
00406 203*      IF (NGP-30) 840,360,840
00411 204*      360 ISEP = 1
00412 205*      GO TO 340
00412 206*      C.....
00412 207*      C.....FOUND A D, CHECK FOR DOUBLE PRECISION
00413 208*      370 IF(N.EQ.1) GO TO 450
00415 209*      IF (IH.EQ.1) GO TO 460
00417 210*      IF (IO.EQ.1) GO TO 450
00421 211*      IOTEST = 1
00422 212*      NGP = 4
00423 213*      GO TO 520
00423 214*      C.....
00423 215*      C.....FOUND AN E, CHECK FOR REAL
00424 216*      380 IF(N.EQ.1) GO TO 450
00426 217*      IF (IH.EQ.1) GO TO 460
00430 218*      IF (IO.EQ.1) GO TO 450
00432 219*      NGP = 2
00433 220*      GO TO 520

```

```

00433 221* C.....
00433 222* C.....FOUND A DECIMAL POINT
00434 223* 390 IF (IPER.EQ.1) GO TO 860
00436 224* IPER = 1
00437 225* NGP = 2
00440 226* GO TO 460
00440 227* C.....
00440 228* C.....FOUND AN O, CHECK FOR OCTAL
00441 229* 400 IF (N.NE.1) GO TO 450
00443 230* IO = 1
00444 231* GO TO 460
00444 232* C.....
00444 233* C.....END OF RECORD
00445 234* 420 IF (IH.EQ.1) GO TO 470
00447 235* IF (IO.NE.1) GO TO 770
00451 236* GO TO 690
00451 237* C.....
00451 238* C.....BCD DATA
00452 239* 450 IH = 1
00453 240* 460 CONTINUE
00455 241* NN = 73
00456 242* IF (IH.EQ.1) GO TO 470
00460 243* IF (IPER.EQ.1) GO TO 800
00462 244* IF (IO.EQ.1) GO TO 690
00464 245* IF (IMINUS.EQ.1) I=I+1
00466 246* NCOL = 72-I
00467 247* GO TO 780
00467 248* C.....
00467 249* C.....BCD STRING
00470 250* 462 L = NN+1
00471 251* DO 464 LI=L,72
00474 252* IF (ICOM(LI).EQ.1APTST) IF (LI-L) 840,840,466
00500 253* 464 CONTINUE
00502 254* LI=73
00503 255* IEND=1
00504 256* 466 NCOL = LI-L
00505 257* NGP = 6
00506 258* CALL PACK (ICOM(L), NAME, NCOL)
00507 259* NN = LI
00510 260* GO TO 485
00511 261* 470 IF (NN.GT.72) NN = 72
00513 262* IF (ICOM(NN).EQ.1CTST) GO TO 500
00515 263* IF (ICOM(NN).EQ.1STR) GO TO 500
00517 264* IF (ICOM(NN).EQ.1BTST) GO TO 500
00521 265* NCOL = NN+1+1
00522 266* NGP = 6
00523 267* 480 CALL PACK (ICOM(1), NAME, NCOL)
00524 268* IF (NAME(1).EQ.1BEG) GO TO 510
00526 269* IF (NAME(1).EQ.1NDCAS) GO TO 510
00530 270* 485 KRB (J) = NGP
00531 271* KRB (J+1) = NCOL
00532 272* J = J+2
00533 273* DO 490 L=1,NCOL
00536 274* KRB (J) = NAME (L)
00537 275* 490 J = J+1
00541 276* GO TO 790
00541 277* C.....
00542 278* 500 NN = NN+1

```

```

00543 279* GO TO 470
00543 280* C.....
00544 281* 510 KRBF(J) = 1
00545 282* KRBF(J+1) = NAME(1)
00546 283* KRBF(J+2) = NAOR
00547 284* J = J+3
00550 285* GO TO 790
00550 286* C.....
00551 287* 520 IF (ICOM(N+1).NE.IMINTS) GO TO 530
00553 288* MINUSX = 1
00554 289* GO TO 540
00554 290* C.....
00555 291* 530 IF (ICOM(N+1).NE.IPLTS) GO TO 550
00557 292* 540 N = N+1
00557 293* C.....
00557 294* C.....PICK UP EXPONENT
00560 295* 550 NCOL = 0
00561 296* 552 NCOL = NCOL + 1
00562 297* 553 NC = N + NCOL + 1
00563 298* IF(NC-73) 555,570,860
00566 299* 555 IF(ICOM(NC).EQ.ICTST) GO TO 570
00570 300* IF (ICOM(NC).EQ.ISTH) GO TO 570
00572 301* IF (ICOM(NC).EQ.IBTST) GO TO 552
00574 302* IF (NCOL.GT.1) GO TO 552
00576 303* IF (ICOM(NC).NE.IMINTS) IF (ICOM(NC).IPLTS) 552, 558, 552
00602 304* MINUSX = 1
00603 305* 558 N = NC
00604 306* GO TO 553
00605 307* 570 CALL BCDINT (ICOM(N+1), IEXP, NCOL)
00606 308* IF (NCOL.LT.0) GO TO 830
00610 309* N = N + NCOL
00611 310* 580 IPTSW = 0
00612 311* DP = 0.000
00613 312* NDECL = 0
00614 313* NDECR = 0
00615 314* IF (ICOM(I).NE.IMINTS) GO TO 590
00617 315* IMINUS = 1
00620 316* GO TO 600
00620 317* C.....
00621 318* 590 IF (ICOM(I).NE.IPLTS) GO TO 610
00623 319* 600 I = I+1
00624 320* IF (I.GE.NN) GO TO 660
00626 321* 610 DO 620 L=1,10
00631 322* IF (ICOM(I).NE.BCDTAL(L)) GO TO 620
00633 323* XX = L-1
00634 324* GO TO 630
00634 325* C.....
00635 326* 620 CONTINUE
00637 327* IF (ICOM(I).EQ.IBTST) GO TO 600
00641 328* IF (ICOM(I).NE.IPTST) GO TO 850
00643 329* IPTSW = 1
00644 330* GO TO 600
00644 331* C.....
00645 332* 630 IF (IPTSW.NE.0) GO TO 640
00647 333* NDECL = NDECL+1
00650 334* GO TO 650
00650 335* C.....
00651 336* 640 NDECR = NDECR+1

```

```

      @      FOR,*  CDDATA,CDDATA

00652 337*      650 DP = DP*10.0 + XX
00653 338*      GO TO 600
00653 339*      C.....
00654 340*      660 IF (MINUSX.EQ.1) IEXP = -IEXP
00656 341*      IEXP = IEXP - NDECX
00656 342*      C.....
00656 343*      C.....TEST FOR UNDERFLOW AND OVERFLOW
00657 344*      IF (IEXP.LT.-LE(IDTEST+1)) DP = 0.00
00661 345*      IF (IEXP.GT. LE(IDTEST+1)) DP = 10.00**LE(IDTEST+1)
00663 346*      IF (IEXP) 662, 666, 664
00666 347*      662 DP = DP/(10.00**ABS(IEXP))
00667 348*      GO TO 666
00670 349*      664 DP = DP*(10.00**IEXP)
00671 350*      666 IF (IMINUS.EQ.1) DP = -DP
00673 351*      KRBF(J) = NGP
00674 352*      IF (IDTEST.EQ.1) GO TO 670
00676 353*      SP = DP
00677 354*      KRBF(J+1) = ISP
00700 355*      J = J+2
00701 356*      GO TO 680
00701 357*      C.....
00702 358*      670 KRBF(J+1) = IDP(1)
00703 359*      KRBF(J+2) = IDP(2)
00704 360*      J = J+3
00705 361*      680 I = N
00706 362*      GO TO 130
00706 363*      C.....
00706 364*      C.....OCTAL INTEGER
00707 365*      690 IIDP = 0
00710 366*      IX = 0
00711 367*      IJK = I+1
00712 368*      IF (NN.GT.72) NN = 72
00714 369*      L = NN - I
00715 370*      CALL SQZB (ICOM(IJK), L)
00716 371*      700 I = I+1
00717 372*      IF (I.GT.72) GO TO 720
00721 373*      DO 710 L=1,8
00724 374*      LL = L
00725 375*      IF (ICOM(I).EQ.8COT8L(L)) GO TO 750
00727 376*      710 CONTINUE
00731 377*      IF (ICOM(I).EQ.1BTST) GO TO 720
00733 378*      IF (ICOM(I).NE.1CTST) IF (ICOM(I)-ISTR) 850,720,850
00737 379*      720 IF (IIDP.EQ.12) GO TO 740
00741 380*      DO 730 L=IIDP,11
00744 381*      730 IX = IX*8
00746 382*      740 AX = OR(IX,IFLAG)
00747 383*      KRBF(J) = 7
00750 384*      KRBF(J+1) = IX
00751 385*      J = J+2
00752 386*      IO = 0
00753 387*      GO TO 790
00753 388*      C.....
00754 389*      750 IF (IJK.NE.1) GO TO 760
00756 390*      IFLAG = 0
00757 391*      IF (LL.LT.5) GO TO 760
00761 392*      IFLAG = IOCTM
00762 393*      LL = LL-4

```



```

00764 395* IIDP = IIDP+1
00765 396* GO TO 700
00765 397* C.....
00766 398* 770 IF (IPER.EQ.1) GO TO 800
00770 399* IF (IMINUS.EQ.0) IF (ICOM(1)-IPLTS) 776, 773, 776
00774 400* 773 I = I + 1
00775 401* 776 NCOL = N - I
00776 402* 780 CALL BCDINT(ICOM(1), INT, NCOL)
00777 403* IF (NCOL.LT.0) GO TO 810
01001 404* IF (IMINUS.EQ.1) INT = -INT
01003 405* KRBF(J) = 3
01004 406* KRBF(J+1) = INT
01005 407* J = J+2
01006 408* 790 I = NN
01007 409* GO TO 130
01007 410* C.....
01010 411* 800 IEXP = 0
01011 412* GO TO 580
01011 413* C.....
01011 414* C.....ERROR ON INPUT STREAM
01012 415* 810 N = I - 1 - NCOL
01013 416* GO TO 860
01014 417* 820 N = NN - NCOL
01015 418* GO TO 860
01016 419* 830 N = N - NCOL
01017 420* GO TO 860
01020 421* 840 N = L1
01021 422* GO TO 860
01022 423* 850 N = 1
01023 424* 860 KRBF(J) = -1
01024 425* WRITE (KOUT,870) ICOM(N),N
01030 426* 870 FORMAT(26H ILLEGAL USE OF CHARACTER A1,19H IN OR AFTER COLUMN13)
01031 427* GO TO 890
01031 428* C.....STORE VALUE OF ZERO IN BUFFER TO INDICATE END OF CARD
01032 429* 880 KRBF(J) = 0
01033 430* 890 KRBF(109) = J
01034 431* RETURN
01035 432* END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

CDDATA SYMBOLIC
CDDATA CODE RELOCATABLE

14 JUN 71	15:05:38	0	01650122	14	432	(DELETED)
14 JUN 71	15:05:38	1	01663762	36	1	(DELETED)
		0	01664026	14	109	

56 HDG B FOR, CHAM, CHAM

3.2.13 CHAM (B1 - PROPELLANT THRUSTOR GAS GENERATOR AND TURBOPUMP)

FOR, CHAM, CHAM
UNIVAC 1108 FORTRAN V LEVEL 2204 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:26:52

31 AUG 71

9:26:52.148

SUBROUTINE CHAM ENTRY POINT 001545

TURBOP ENTRY POINT 001572

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	001577
0000	*DATA	000126
0002	*BLANK	000000
0003	INDATA	011610
0004	COM	006525
0005	CONS	000003
0006	CCPCX	000007

EXTERNAL REFERENCES (BLOCK, NAME)

0007	OPTCP
0010	OPTCV
0011	HPTCP
0012	HPTCV
0013	OPTD
0014	HPTD
0015	NERR2S
0016	NEXP5S
0017	SQRT
0020	NEXP6S
0021	NWDUS
0022	NI01S
0023	NI02S
0024	NERR3S

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000036	IL	0001	000757	11L	0001	000775	12L	0001	000322	120L	0001	000013	123G
0001	001012	15L	0001	000421	150L	0001	000503	160L	0001	000164	164G	0001	000604	170L
0001	000210	177G	0000	000036	190F	0001	000004	191L	0001	000725	195L	0001	000051	2L
0001	000122	20L	0001	001525	200L	0001	000277	222G	0001	000126	30L	0001	000715	350G
0001	000152	42L	0001	000063	5L	0001	000236	55L	0001	000257	60L	0000	R 000026	A
0003	I 006221	AJ	0004	R 000000	AREA	0003	006074	AREAE	0004	R 000074	AREAI	0004	R 000170	AREAK
0004	R 000132	AREAD	0003	R 006066	AREAT	0003	R 006121	ARINJ	0003	R 006625	ATD	0003	R 006613	ATI
0003	000760	ATD	0000	R 000027	B	0000	R 000030	C	0003	006157	CDC	0003	R 006644	CEF1
0003	R 006651	CEF2	0004	R 005060	CF	0004	R 006423	CGGTC	0004	R 006436	CGTANK	0004	R 006431	CLTANK
0004	R 005014	CONCT	0003	R 005714	CP	0004	R 000000	CPCX	0000	R 000016	CPGAS	0004	R 006443	CPJU
0000	R 000021	CPX	0003	R 006466	CP2	0004	R 005006	CSTAR	0003	R 006203	CS2	0003	I 006117	CTW
0003	R 006102	CV	0004	R 006355	CVEL	0000	R 000017	CVGAS	0000	R 000022	C6	0000	R 000023	C9
0000	R 000025	D	0004	R 000036	DELXL	0003	R 000727	D1AD	0004	R 000226	DIAL1	0003	R 000734	D1AP
0003	R 006675	D1AT	0004	R 006277	DMVENT	0000	R 000032	EP	0004	R 006360	ETAT	0005	R 000002	F8
0004	R 006370	F8PC	0004	R 006376	F8TC	0004	R 006362	F8WC	0004	R 005111	FRL	0005	R 000001	GC
0003	R 006447	GR	0004	R 003132	H1	0004	R 003036	HU	0011	R 000000	HPTCP	0012	R 000000	HPTCV

0014 R 000000 HPTD	0003 I 003322 HRAD	0003 I 005763 ICHAM	0004 I 005100 ICHON	0006 I 000006 ICX
0000 I 000012 II	0003 I 000551 IPROP	0003 I 000637 IPUMI	0003 I 006637 IPUMO	0003 R 006143 ISP
0004 R 005052 ISPT	0003 R 006207 IS2	0000 I 000013 JJ	0004 I 003606 JUN	0000 I 000020 K
0003 R 003413 KA	0000 R 000000 KAY	0003 R 006632 KTD	0003 R 006620 KTI	0004 I 005066 MEX
0004 R 004756 MR	0004 R 005102 MWC	0003 R 006173 MW2	0000 I 000011 N	0003 I 000146 NCHAM
0003 I 006116 NCOEF	0000 I 000001 NGGTP	0004 I 002552 NGR	0003 I 000100 NODEL	0003 I 000553 NPLINE
0004 I 002646 NPR	0004 I 002742 NRE	0007 R 000000 OPTCP	0010 R 000000 OPTCV	0013 R 000000 OPTD
0000 R 000014 P	0003 R 006120 PATH	0004 R 000264 PB	0004 R 004764 PC	0003 R 006151 PCI
0004 R 004772 PCN	0003 R 000644 PDELP	0003 R 006213 PDROP	0004 R 005074 PE	0004 R 000272 PG
0004 R 003620 PGT	0000 R 000024 PGTC	0005 R 000000 PI	0004 R 005036 PMR	0004 R 006241 POWC
0004 R 006350 POWP	0004 R 006343 POWT	0003 R 000741 POWO	0003 R 000746 POW1	0003 R 000753 POW2
0003 R 006663 POW3	0004 R 006300 PPI	0004 R 006305 PPO	0004 R 006331 PTI	0004 R 006336 PTO
0003 R 000651 PWO	0003 R 000656 PW1	0003 R 000663 PA2	0004 R 006357 R	0003 R 005754 RFLAG
0003 R 005711 RGAS	0004 R 001422 RHOG	0003 R 000546 RHOL	0003 R 000670 RPMO	0000 R 000004 RPHP
0004 R 006312 RPMT	0003 R 000000 S	0000 R 000615 T	0004 R 005044 TC	0003 R 006177 TC2
0004 R 006416 THOC	0003 R 006135 THRT	0004 R 006411 TPCG	0004 R 006404 TPCL	0000 R 000034 TTEIS
0003 R 001132 TTEMP	0004 R 006317 TTI	0004 R 006324 TTO	0003 R 002262 TTEMP	0004 R 003226 TWALL
0000 R 000033 TX	0004 R 006356 U	0004 R 003416 UAO	0000 R 000031 V	0004 R 003512 VEL
0000 R 000002 W	0003 R 003423 WDOTG	0004 R 006265 WI	0004 R 004750 WNOZ	0004 R 006253 WO
0003 R 006670 WP	0004 R 006361 WT	0004 R 006246 WTCG		

```

00101 10 SUBROUTINE CHAM(1)
00101 20 C
00103 30 REAL KA,MR,ISP,KAY,MW2,IS2,ISPT
00103 40 MWC,KTD,KTI
00104 50 C
00104 60 INTEGER AJ,NGGTP
00104 70 C
00104 80 CTH
00105 90 C
00105 100 DIMENSION ICHAM(6,2),AREAT(6),AREAE(6),CV(6,2),TTEMP(30,20),W(2)
00105 110 ARINJ(6,2),RGAS(2),PCI(6),ISP(6)
00105 120 NODEL(20),NPLINE(30),KA(2),WDOTG(30,20),THRT(6)
00105 130 TC2(4),MW2(4),CS2(4),IS2(4),PDROP(6)
00105 140 IPUMI(5),PDELP(5),RPMO(5),UAD(5),DIAP(5),POWO(5)
00105 150 POW1(5),POW2(5),POW3(5),GR(5),ATI(5),KTI(5),ATD(5)
00105 160 KTD(5),ATO(5),RPMP(5),CEF1(5),CEF2(5)
00105 170 PAO(5),PW1(5),PW2(5),DIAT(5),CP2(5),IPUMO(5),CP(30)
00105 180 TTEMP(30,20),RHOL(3),WP(5)
00105 190 C
00106 200 COMMON /INDATA/S(5000)
00106 210 C
00107 220 COMMON /COM/AREA(30),DELXL(30),AREAI(30),AREAO(30),AREAK(30)
00107 230 DIALI(30),PB(6),PG(30,20),RHOG(30,20),NGR(30,2)
00107 240 NPR(30,2),NRE(30,2),HO(30,2),HI(30,2),TWALL(30,2)
00107 250 HRAD(30,2),UAO(30,2),VEL(30,2),JUN(10),PGT(30,20)
00107 260 WNOZ(6),MK(6),PC(6),PCN(6,2),CSTAR(6),CONCT(3,6)
00107 270 PMR(6),TC(6),ISPT(6),CF(6),MEX(6),PE(6),MWC(6),ICHON
00107 280 FRL(30,20),POWC(5),WTGC(5),WO(10),WI(10),DMVENT,PPI(5)
00107 290 PPO(5),RPMT(5),TTI(5),TTO(5),PTI(5),PTO(5),POWT(5)
00107 300 POWP(5),CVEL,U,R,ETAT,WT,FBWC(6),FBPC(6)
00107 310 FBTC(6),TPCL(5),TPCG(5),THOC(5),CGGTC(6),CLTANK(5)
00107 320 CGTANK(5),CPJU(5,10)
00107 330 C
00110 340 COMMON /CONS/PI,GC,FB
00111 350 COMMON /CCPCX/ CPCX(6), ICX

```

```

00111 35* C
00112 36* EQUIVALENCE
00112 37*   (S(45), NODEL(1)), (S(362), IPROP), (S(1804), KA(1))
00112 38*   (S(364), NPLINE(1)), (S(3018), RGAS(1)), (S(1203), TTEMP(1,1))
00112 39*   (S(3060), ICHAM(1,1)), (S(3127), AREAT(1)), (S(3154), ARINJ(1,1))
00112 40*   (S(3152), CT*)
00112 41*   (S(3139), CV(1,1)), (S(3151), NCOEF), (S(3053), RFLAG)
00112 42*   (S(3153), PATH), (S(3184), CDC), (S(3133), AREAE(1))
00112 43*   (S(3172), ISP(1)), (S(3166), THRT(1)), (S(3196), MW2(1))
00112 44*   (S(3178), PC1(1)), (S(103), NCHAM), (S(1812), WDOTG(1,1))
00112 45*   (S(3200), TC2(1)), (S(3204), CS2(1)), (S(3208), IS2(1))
00112 46*   (S(3212), PDROP(1)), (S(3218), AJ)
00112 47*   (S(416), IPUM(1)), (S(421), POELP(1)), (S(426), PWD(1))
00112 48*   (S(431), PA1(1)), (S(436), PA2(1)), (S(441), RPMU(1))
00112 49*   (S(472), DIAP(1)), (S(477), DIAP(1)), (S(482), POAO(1))
00112 50*   (S(487), POW1(1)), (S(492), POW2(1)), (S(3508), POW3(1))
00112 51*   (S(3368), GR(1)), (S(3468), AT1(1)), (S(3473), KT1(1))
00112 52*   (S(3478), ATD(1)), (S(3483), KTD(1)), (S(497), ATO(1))
00112 53*   (S(3493), CEF1(1)), (S(3498), CEF2(1)), (S(3021), CP(1))
00112 54*   (S(3518), DIAT(1)), (S(3383), CP2(1)), (S(3488), IPUMO(1))
00112 55*   (S(603), TTEMP(1,1)), (S(359), RHOL(1)), (S(3513), WP(1))
00112 56* C
00113 57* NGGTP = 0
00114 58* GO TO 191
00115 59* ENTRY TURBOP(1)
00117 60* NGGTP = 1
00120 61* 191 CONTINUE
00121 62* WNOZ(1) = 0.
00122 63* DO 10 N=1,2
00125 64*   II = ICHAM(1,N)
00126 65*   JJ = NODEL(1)
00127 66*   P = PG(II,JJ)
00130 67*   T = TTEMP(II,JJ)
00131 68*   IPROP = NPLINE(1)
00132 69*   GO TO (1,2), IPROP
00132 70* C QXYGEN
00133 71*   1 CPGAS = OPTCP(P,T)
00134 72*   CVGAS = OPTCV(P,T)
00135 73*   GO TO 5
00135 74* C HYDROGEN
00136 75*   2 CPGAS = HPTCP(P,T)
00137 76*   CVGAS = HPTCV(P,T)
00140 77*   5 CONTINUE
00141 78*   RGAS(IPROP) = (CPGAS - CVGAS) * 778.156
00142 79*   KA(IPROP) = CPGAS / CVGAS
00143 80*   W(N) = WDOTG(II,JJ)
00144 81*   WNOZ(1) = WNOZ(1) + W(N)
00145 82* 10 CONTINUE
00147 83*   IF (NPLINE(1).EQ.1) GO TO 20
00151 84*   MR(1) = W(1)/W(2)
00152 85*   GO TO 30
00153 86* 20 MR(1) = W(2)/W(1)
00154 87* 30 CONTINUE
00155 88*   IF (MR(1) .LE. 6.0) GO TO 42
00157 89*   ISPT(1) = 442.4919 - 1.46667*(MR(1) - 6.0)
00160 90*   CSTAR(1) = 7673.8046 - 220.0*(MR(1) - 6.0)
00161 91*   GO TO 55
00162 92* 42 PMR(1) = 1.0

```

```

00163 93* DO 40 K=2,NCOEF
00166 94* PMR(K) = MR(1)*K(K-1)
00167 95* 40 CONTINUE
00171 96* MAC(1) = 0.
00172 97* TC(1) = 0.
00173 98* CPX = 0.
00174 99* CSTAR(1)=0.
00175 100* ISPT(1) = 0.0
00176 101* DO 50 K=1,NCOEF
00201 102* MAC(1) = MAC(1) + MAC(K)*PMR(K)
00202 103* TC(1) = TC(1) + TC2(K)*PMR(K)
00203 104* CSTAR(1) = CSTAR(1) + CS2(K)*PMR(K)
00204 105* ISPT(1) = ISPT(1) + IS2(K)*PMR(K)
00205 106* CPX = CPX + CP2(K) * PMR(K)
00206 107* 50 CONTINUE
00206 108* C STORE CPX FOR HEAT EXCHANGER H2OH2 - ROUTINE
00210 109* CPCX(1) = CPX
00211 110* 55 CONTINUE
00211 111* C CF = THRUST COEFFICIENT
00212 112* CF(1) = GC*ISPT(1)/CSTAR(1)
00213 113* IF (CTH,NE.4) GO TO 60
00215 114* PCI(1) = WNOZ(1) *CSTAR(1) / (AREAT(1) *GC)
00216 115* 60 CONTINUE
00216 116* C ISP IS COMPUTED INTERNALLY
00216 117* C INPUT 2 OF THE FOLLOWING AND THE THIRD AS A STATE VARIABLE -
00216 118* C PCI, AREAT, THRT
00217 119* ISP(1) = ISPT(1)
00220 120* 110 CONTINUE
00221 121* DO 170 N=1,2
00224 122* II = ICHAM(1,N)
00225 123* JJ = NODEL(II)
00226 124* IPROP = NPLINE(II)
00227 125* KAY = KA(IPROP)
00230 126* W(N) = ADOTG(II,JJ)
00231 127* IF (AJ.EQ.1) GO TO 150
00233 128* 120 C6 = ARINJ(II,N)*CV(II,N)*SQRT(GC*KAY/(RGAS(IPROP) *
00233 129* TTTEMP(II,JJ))*2.0/(KAY-1.0))
00234 130* IF (PCI(1) *GE. PGT(II,JJ)) PCI(1) = 0.9*PGT(II,JJ)
00236 131* 130 CONTINUE
00237 132* C9 = PCI(1)/PGT(II,JJ)
00237 133* C CV = INJECTOR DISCHARGE COEFFICIENT
00237 134* C FLOWRATE THRU INJECTOR
00240 135* CONCT(N,1) = 1. - PGT(II,JJ)*C6*SQRT(C9**2./KAY) -
00240 136* C9**((KAY+1.)/KAY)) / W(N)
00241 137* 140 CONTINUE
00242 138* GO TO 160
00243 139* 150 CONTINUE
00244 140* PGTC = PCI(1) * PDROP(1)
00245 141* C9 = PCI(1)/PGTC
00245 142* C
00245 143* C AREA INJECTOR (FLO)
00245 144* C
00246 145* ARINJ(1,N) = WDOTG(II,JJ)/(PGT(II,JJ)*CV(II,N)*SQRT(GC*KAY*2.0/
00246 146* (RGAS(IPROP)*TTTEMP(II,JJ)*(KAY-1.))*C9**2./KAY)-C9**
00246 147* ((KAY+1.)/KAY)))
00247 148* GO TO 120
00250 149* 160 CONTINUE
00251 150* IF (RFLAG),170,

```

```

00254 151*      WRITE (6,190) I, II, JJ, IPROP, N, AJ, NPLINE(II), N, KAY, H(N), WNOZ(II), C6, A
00254 152*      *RINJ(1, N), CV(1, N), GC, RGAS(II), TTTEMP(II, JJ), PGT(II, JJ), PCN(1, N), C9
00254 153*      *P0PROP(1), *WDOTG(II, JJ), ISP(II), THRT(II), ISPT(II), PCI(II)
00310 154*      170 CONTINUE
00310 155*      C  CONSTRAINT EQ THRUST OR ISP
00312 156*      180 CONCT(3, 1) = 1. - THRT(II)*CSTAR(II)/(ISP(II)*AREAT(II)*GC / PCI(II)
00313 157*      IF (RFLAG), 195,
00316 158*      *RITE(6,190) I, II, JJ, IPROP, N, N, NPLINE(II), WCOEF, KAY, WNOZ(II), C6, R
00316 159*      2GAS(II), MR(II), W(II), N(2), MWC(II), TC(II), CSTAR(II), ISP(II), CF(II), PC(II), T
00316 160*      3HRT(II), PCI(II), AREAT(II), (CONCT(N, II), N=1, 3), GC, THRT(II)
00356 161*      190 FORMAT(/'24X12CHAM ROUTINE', 5X, 8I6, // '4(1PBE15.7)')
00357 162*      195 KAY = CPX/(CPX-1.9852/MWC(II))
00360 163*      IF (NGGTP .EQ. 0) GO TO 200
00360 164*      C  IPUM1 = LINE CONNECTED TO PUMP INLET
00362 165*      II = IPUM1(II)
00363 166*      JJ = NODEL(II)
00364 167*      IPROP = NPLINE (II)
00364 168*      C  COMPUTE FLUID DENSITY
00365 169*      GO TO (11, 12), IPROP
00365 170*      11 RHOL(IPROP) = OPTD (PG(II, JJ), TTEMP(II, JJ) )
00367 171*      GO TO 15
00370 172*      12 RHOL(IPROP) = HPTD (PG(II, JJ), TTEMP(II, JJ) )
00371 173*      15 CONTINUE
00371 174*      C  PUMP CALCULATIONS
00371 175*      C
00371 176*      C  PRESSURE PUMP INLET
00372 177*      PPI(II) = PG(II, JJ)
00372 178*      C  PUMP FLOWRATE
00373 179*      WP(II) = WDOTG(II, JJ)
00373 180*      C  PRESSURE OUT
00374 181*      PPO(II) = PPI(II) + PDELP(II)
00374 182*      C  PDELP(II) = PUMP PRESSURE HEAD, PSIA
00374 183*      C  PUMP ACTUAL DIAMETER / PUMP DESIGN DIAMETER
00375 184*      D = DIAP(II) / DIAD(II)
00375 185*      C  SPEED, S IS LABELED AS V
00375 186*      C  SPEED V IS POSITIVE ROOT OF QUADRATIC EQUATION
00376 187*      A = D**2 * P40(II)
00377 188*      B = PH1(II) * WP(II) / D
00377 189*      C = PA2(II) * WP(II)**2 / D**4 - PDELP(II)
00400 190*      V = (-B + SQRT(B**2 - 4. * A * C) ) / (2. * A)
00401 191*      C  PUMP SPEED / PUMP DESIGN SPEED = F ( HEAD CURVE )
00402 192*      RPMP(II) = RPMO(II) * V
00402 193*      C  RPMP = PUMP SPEED, REV/SEC
00402 194*      C  RPMO = PUMP DESIGN SPEED, RPM
00402 195*      C  DIAD = PUMP DESIGN DIA. , INCHES
00402 196*      C  DIAP = PUMP DIA. , INCHES
00402 197*      C  PUMP POWER
00403 198*      POWP(II) = V**3 * D**5 * POWO(II) + (V*D)**2 * POW1(II) * WP(II)
00403 199*      * + V * POW2(II) * WP(II)**2 / D + (WP(II)/D)**3 / D * POW3(II)
00403 200*      C  POWO = COEFFICIENT IN PUMP DESIGN POWER CURVE FIT
00403 201*      C  POW1 = COEFFICIENT IN PUMP DESIGN POWER CURVE FIT
00403 202*      C  POW2 = COEFFICIENT IN PUMP DESIGN POWER CURVE FIT
00403 203*      C  POW3 = COEFFICIENT IN PUMP DESIGN POWER CURVE FIT
00404 204*      EP = PDELP(II) * WP(II) * 144. / (RHOL(IPROP) * POWP(II) )
00405 205*      TX = (1.-EP) * POWP(II) / (FB * WP(II) * CP(II) ) + TTEMP(II, JJ)
00405 206*      C  ... TURBINE EQUATIONS ...
00405 207*      C  SPEED, REV/SEC
00406 208*      RPMT(II) = RPMP(II)*GR(II)

```

```

00407 209. TT1(I) = TC(I)
00407 210. C TURBINE ISENTROPIC DISCHARGE TEMPERATURE (DEG-R)
00410 211. TTE1S = TT1(I)*(ATI(I)/ATD(I))*((2.+(KAY-1.)/(KAY+1.))
00411 212. PT1(I) = PCI(I)
00411 213. C PRESSURE DROP GG TO TURBINE INCLUDED IN KT, ADIABATIC LINE COULD BE
00411 214. C USED
00411 215. C PRESSURE TURBINE OUT BASED SONIC FLOW OUT OF DUCT TO ATM.
00411 216. C ISENTROPIC SPOUTING VELOCITY, FT/SEC
00412 217. CVEL = SQRT(2.0*CPX*(TC(I)-TTE1S)*778.26*GC)
00413 218. U = 3.14159*DIAT(I)/12.0*RPMT(I)/60.0
00414 219. R = U/CVEL
00414 220. C EFFICIENCY
00415 221. ETAT = CEF2(I)*R + CEF1(I)*R
00415 222. C TURBINE POWER, FT-LBF/SEC
00416 223. POWT(I) = ETAT*778.26*CPX*WNOZ(I)*(TC(I)-TTE1S)
00416 224. C TURBINE ACTUAL DISCHARGE TEMPERATURE (DEG-R)
00417 225. TTO(I) = TC(I)*(1. - ETAT)/(1. - TTE1S/TC(I))
00417 226. C TURBINE CHOKED FLOWRATE, FT/SEC
00420 227. WT = PT1(I)*ATI(I)*KT1(I)*SQRT(MWC(I)/1545./TTO(I)*GC*KAY*(2./
00420 228. *(KAY+1.))*((KAY+1.)/(KAY-1.)))
00421 229. PTO(I) = WT/(ATD(I)*KT1(I)*SQRT(MWC(I)/1545./TTO(I)*GC*KAY*(2./
00421 230. *(KAY+1.))*((KAY+1.)/(KAY-1.)))
00421 231. C TURBINE-GG FLOW CONSTRAINT EQ
00422 232. WTGC(I) = 1. - WT / WNOZ(I)
00422 233. C CONSTRAINT PUMP-TURBINE POWER
00423 234. POWC(I) = 1. - POWT(I)/POWP(I)
00423 235. C IPUMO = LINE CONNECTED PUMP DISCHARGE
00424 236. I1 = IPUMO(I)
00425 237. JJ = 1
00426 238. IPROP = NPLINE(I1)
00427 239. WDOTG(I1, JJ) = WP(I)
00430 240. TTEMP(I1, JJ) = TX
00431 241. PG(I1, JJ) = PPO(I)
00432 242. IF (RFLAG), 200,
00435 243. WRITE(6, 190) I1, JJ, IPROP, N, AJ, NPLINE(I), N
00435 244. *, PPI(I), PPO(I), PDELP(I), PWO(I)
00435 245. *, PW1(I), PA2(I), WP(I), RPMT(I)
00435 246. *, GR(I), TC(I), TT1(I), TTO(I)
00435 247. *, ATI(I), ATD(I), PCI(I), PT1(I)
00435 248. *, TC(I), CVEL, DIAT(I), U
00435 249. *, R, CEF2(I), CEF1(I), ETAT
00435 250. *, POWT(I), PT1(I), KT1(I), PTO(I)
00435 251. *, WT, WTGC(I), POWC(I), POWP(I)
00435 252. *, WP(I), CPX, KAY, CP2(I)
00513 253. 200 RETURN
00514 254. END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

D *DIAGNOSTIC* MESSAGE(S)

CHAM	CODE	SYMBOLIC	31 AUG 71	09:25:01	0	02076324	14	254	(DELETED)
CHAM	CODE	RELOCATABLE	31 AUG 71	09:25:01	1	02105270	48	1	(DELETED)
W HDG	R	FOR, • CHOICE, CHOICE			0	02105350	14	100	

3.2.14 CHOICE

FOR, CHOICE, CHOICE
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:26:56

31 AUG 71

9:26:56.357

SUBROUTINE CHOICE ENTRY POINT 000445

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000660
0000	*DATA	000037
0002	*BLANK	000000
0003	INDATA	011610

EXTERNAL REFERENCES (BLOCK, NAME)

0004	HEATEX
0005	NKDUS
0006	NIO15
0007	NIO25
0010	NERR25
0011	NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000101	110L	0001	000121	140L	0001	000130	150L	0001	000141	160L	0001	000223	170L	
0001	000237	190L	0001	000246	200L	0001	000277	210L	0001	000341	220L	0000	000015	230F	
0001	000415	235L	0001	000427	240L	0001	000433	250L	0001	000016	40L	0001	000023	50L	
0001	000034	70L	0001	000040	80L	0001	000051	90L	0000	R	000013	81	0000	R	
0000	I	000006	J	0000	I	000014	JOUT	0000	I	000001	KRET	0000	R	000011	PIN
0003	R	005754	RFLAG	0003	006316	RI	0003	006424	RO	0003	R	000000	S	0003	I
0000	R	000012	XT12	0000	R	000003	XT02	0000	R	000010	X1	0000	R	000004	X2
0000	R	000002	Y2									0000	R	000007	Y1

```

00101 1* SUBROUTINE CHOICE (LN,LI,T11,T12,T01,T02,P11,P12,P01,P02,*D1,
00101 2* 1 ADD,QT,LO,X1,X0)
00101 3* CC THIS SUBROUTINE DETERMINES WHETHER THE HEAT EXCHANGER IS
00101 4* CC OPERATING AS A PARALLEL OR A COUNTER FLOW DEVICE FROM THE
00101 5* CC FLOWRATE SIGNS, AND THEN DETERMINES WHICH END TO START
00101 6* CC INTO FOR INTEGRATION. FOR PARALLEL FLOW HEAT EXCHANGERS,
00101 7* CC INTEGRATION IS IN THE DIRECTION OF FLOWRATE. FOR COUNTERFLOW
00101 8* CC HEAT EXCHANGERS, AN ITERATION IS NEEDED TO CONVERGE.
00101 9* CC T = TEMP (DEG,R) ( SUBSCRIPT 1 = INSIDE )
00101 10* CC P = PRESS (PSIA) ( 0 = OUTSIDE )
00101 11* CC *D= FLOWRATE FROM END 1 TO END 2 (POUNDS/SEC)
00101 12* CC QT= TOTAL HEAT TRANSFER RATE (BTU/SEC IN DEG,R)
00101 13* CC IS EITHER FLOWRATE ZERO
00103 14* INTEGER TYPE
00103 15* C
00104 16* DIMENSION TYPE(5),RI(5),RO(5)
00104 17* C

```



```

00105 18* COMMON /INDATA, 5(5000)
00105 19* C
00106 20* EQUIVALENCE
00106 21* * (S(3274),TYPE(1)) , (S(3279),RI(1)) , (S(3349),RO(1))
00106 22* * , (S(3053),RFLAG)
00106 23* C
00107 24* IF (ND1) 10,50,10
00112 25* 10 IF (ND0) 90,20,90
00115 26* 20 IF (ND1) 30,80,40
00120 27* 30 T11=T12
00121 28* P11=P12
00122 29* GO TO 80
00123 30* 40 P12=P11
00124 31* T12=T11
00125 32* GO TO 80
00126 33* 50 IF (ND0) 60,80,70
00131 34* 60 T01=T02
00132 35* P01=P02
00133 36* GO TO 80
00134 37* 70 T02=T01
00135 38* P02=P01
00136 39* 80 QT=0.0
00137 40* GO TO 250
00137 41* CC FLOWRATES ARE NON ZERO, IS IT PARALLEL OR COUNTER FLOW
00137 42* CC TYPE 3 CROSSFLOW
00140 43* IF (TYPE(LN).EQ.3) GO TO 110
00142 44* 90 IF (ND1/ND0) 110,110,100
00145 45* 100 CONTINUE
00145 46* CC PARALLEL FLOW, COMPUTE CONDITIONS AT END 2 GIVEN
00145 47* CC CONDITIONS AT END 1.
00146 48* CALL HEATEX (LN,L1,L0,T11,T01,T12,T02,P11,P01,P12,P02,ND1,ND0,QT,
00146 49* 1 X1,X0)
00147 50* GO TO 250
00147 51* CC
00147 52* CC COUNTER FLOW, WHICH IS POSITIVE
00150 53* 110 CONTINUE
00151 54* IF (ND1) 170,170,120
00154 55* 120 CONTINUE
00154 56* CC INSIDE FLOW POSITIVE, ASSUME T01 AND ITERATE UNTIL THE
00154 57* CC PROPER VALUE OF T02 IS FOUND
00154 58* CC FIRST GUESS, USE T01 UNLESS HEAT FLUX HAS WRONG SIGN
00155 59* POUT=P02
00156 60* IF (T11-T02) 140,130,140
00156 61* CC NO TEMP DIFFERENCE, NO HEAT TRANSFER
00161 62* 130 T12=T11
00162 63* T01=T02
00163 64* QT=0.0
00164 65* GO TO 250
00165 66* 140 T01=0.5*(T11+T02)
00166 67* KRET=1
00167 68* GO TO 220
00170 69* 150 CONTINUE
00171 70* Y2=X*T02-T02
00172 71* X2=T01
00172 72* CC COMPUTE SECOND GUESS
00173 73* B2=(X*T02-T01)/(T01-T11)
00174 74* T01=(T02+B2*T11)/(1.0+B2)
00175 75* P01=P01+POUT-P02

```

```

00176 76• J=1
00177 77• KRET=2
00200 78• GO TO 220
00201 79• 160 CONTINUE
00202 80• J=J+1
00202 81• CC USE REGULA FALSI FOR SUCCESSIVE GUESSES
00203 82• Y1=XT02-T02
00204 83• X1=T01
00205 84• IF (J.GT.10) GO TO 240
00207 85• IF (ABS(Y1/T02).LE.0.001) GO TO 240
00211 86• T01=X1-Y1*(X2-X1)/(Y2-Y1)
00212 87• P01=P01+POUT-P02
00213 88• X2=X1
00214 89• Y2=Y1
00215 90• GO TO 220
00215 91• CC OUTSIDE FLOW POSITIVE, ASSUME T11 AND ITERATE UNTIL THE
00215 92• CC CORRECT VALUE OF T12 IS FOUND
00215 93• CC FIRST GUESS, USE T11 UNLESS HEAT FLUX HAS WRONG SIGN
00216 94• 170 CONTINUE
00217 95• PIN=P12
00220 96• IF (T01-T12) 190,180,190
00220 97• CC NO TEMP DIFFERENCE OR HEAT TRANSFER
00223 98• 180 T02=T01
00224 99• T11=T12
00225 100• QT=0.0
00226 101• GO TO 250
00227 102• 190 T11=0.5*(T01+T12)
00230 103• KRET=3
00231 104• GO TO 220
00232 105• 200 CONTINUE
00233 106• Y2=X112-T12
00234 107• X2=T11
00234 108• CC COMPUTE SECOND GUESS
00235 109• B1=(XT12-T11)/(T11-T01)
00236 110• T11=(T12+B1*T01)/(1.0+B1)
00237 111• P11=P11+PIN-P12
00240 112• J=1
00241 113• KRET=4
00242 114• GO TO 220
00243 115• 210 CONTINUE
00243 116• CC USE REGULA FALSI FOR SUCCESSIVE GUESSES
00244 117• J=J+1
00245 118• IF (J.GT.10) GO TO 240
00247 119• Y1=XT12-T12
00250 120• X1=T11
00251 121• IF (ABS(Y1/T12).LE.0.001) GO TO 240
00253 122• P11=P11+PIN-P12
00254 123• T11=X1-Y1*(X2-X1)/(Y2-Y1)
00255 124• X2=X1
00256 125• Y2=Y1
00257 126• GO TO 220
00257 127• CC
00257 128• CC HEAT EXCHANGER CALL
00260 129• 220 CONTINUE
00261 130• CALL HEATEX (LN,LI,LO,T11,T01,XT12,XT02,P11,P01,P12,P02,PO1,
00261 131• 1 WDO,QT,XI,XO)
00262 132• IF (RFLAG),235,
00265 133• JOUT=6

```

```

00266 134*      WRITE (JOUT,250) T11,XT12,T01,XT02,QT,PI2,PO1,PO2
00300 135*      230 FORMAT(8E13.6/)
00301 136*      235 GO TO (150,160,200,210),KRET
00301 137*      CC
00301 138*      CC          CONVERGENCE OCCURRED, CLEANUP PROCESS
00302 139*      240 CONTINUE
00303 140*      T12=XT12
00304 141*      T02=XT02
00305 142*      250 RETURN
00306 143*      END
    
```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

O *DIAGNOSTIC* MESSAGE(S)

CHOICE	SYMBOLIC	23 JUN 71	21:25:28	0	01700524	14	143	(DELETED)
CHOICE CODE	RELOCATABLE	23 JUN 71	21:25:28	1	01704446	24	1	(DELETED)
				0	01704476	14	43	

5 HDG 5 FOR,* CMON,CMON

3.2.15 CMON (MONOPROPELLANT THRUSTOR)

FOR, CMON,CMON
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:26:58

31 AUG 71

9:26:58.394

SUBROUTINE CMON ENTRY POINT 001101

STORAGE USED (BLOCK, NAME, LENGTH)

```
0001 *CODE 001137
0000 *DATA 000114
0002 *BLANK 000000
0003 INDATA 011610
0004 COM 006525
0005 CONS 000003
```

EXTERNAL REFERENCES (BLOCK, NAME)

```
0006 OPTCP
0007 OPTCV
0010 HPTCP
0011 HPTCV
0012 NERR2s
0013 NEXP6s
0014 SQRT
0015 NWDUs
0016 NIO1s
0017 NIO2s
0020 NERR3s
```

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000025 IL	0001 000671 100L	0001 000701 110L	0001 000711 120L	0001 000720 130L
0001 000123 135G	0000 000035 140F	0001 000155 144G	0001 001060 150L	0001 000040 2L
0001 000262 20L	0001 000271 40L	0001 000052 5L	0001 000335 50L	0001 000467 60L
0001 000470 70L	0001 000552 80L	0000 R 000025 A	0003 I 006221 AJ	0004 R 000000 AREA
0003 R 006074 AREAE	0004 R 000074 AREAI	0004 R 000170 AREAK	0004 R 000132 AREAO	0003 R 006066 AREAT
0003 R 006121 ARINJ	0000 R 000021 B	0000 R 000034 88	0000 R 000022 C	0003 R 006157 CDC
0004 R 005060 CF	0004 R 006423 CGGTC	0004 R 006436 CGTANK	0004 R 006431 CLTANK	0004 R 005014 CONCT
0000 R 000015 CPGAS	0004 R 006443 CPJU	0004 R 005006 CSTAR	0003 I 006117 CT%	0003 R 006102 CV
0004 R 006355 CVEL	0000 R 000016 CVGAS	0000 R 000027 C6	0000 R 000031 C7	0000 R 000030 C9
0000 R 000024 D	0000 R 000026 DA	0000 R 000032 DCLP	0000 R 000033 DELP	0004 R 000036 DELXL
0004 R 000226 DIAL1	0004 R 006277 DMVENT	0000 R 000020 E	0004 R 006360 ETAT	0005 R 000002 FB
0004 R 006370 FBPC	0004 R 006376 FBTC	0004 R 006362 FBWC	0004 R 005111 FRL	0005 R 000001 GC
0004 R 003132 HI	0004 R 003036 HO	0010 R 000000 HPTCP	0011 R 000000 HPTCV	0004 R 003322 HRAD
0003 I 005763 ICHAM	0004 I 005110 ICMON	0000 I 000011 II	0003 I 000551 IPROP	0000 I 000017 ISAVE
0004 R 005052 ISP	0003 R 006143 ISPI	0000 I 000023 J	0000 I 000013 JJ	0004 I 003606 JUN
0003 R 003413 KA	0000 R 000000 KAY	0003 R 006165 LAMDA	0000 R 000001 ME	0004 R 005066 MEX
0004 R 004756 MR	0004 I 005102 MWC	0000 R 000002 MZE	0003 I 000146 NCHAM	0003 006116 NCOEF
0004 I 002552 NGR	0003 I 000100 NODEL	0003 I 000553 NPLINE	0004 I 002646 NPR	0004 I 002742 NRE
0006 R 000000 OPTCP	0007 R 000000 OPTCV	0000 R 000012 P	0003 R 006120 PATM	0004 R 000264 PB
0004 R 004764 PC	0003 R 006151 PCI	0004 R 004772 PCN	0003 R 006213 PDROP	0004 R 005074 PE
0004 R 000272 PG	0004 R 003620 PGT	0005 R 000000 PI	0004 R 005036 PMR	0004 R 006241 POWC
0004 R 006350 POWP	0004 R 006343 POWT	0004 R 006300 PPI	0004 R 006305 PPO	0004 R 006331 PTI

```

0004 R 006336 PTO      0004 R 006357 R      0003 R 005754 RFLAG      0003 R 005754 RGAS      0004 R 001422 RHOG
0004 R 006312 RPMT      0003 R 000000 S      0000 R 000014 T      0004 R 005044 TC      0004 R 006416 THOC
0003 R 006135 THRT      0000 R 000003 THRT      0004 R 006411 TPCG      0004 R 006404 TPCL      0003 R 001132 TTEMP
0004 R 006317 TTI      0004 R 006324 TIO      0003 R 002262 TTEMP      0004 R 003226 TWALL      0004 R 006356 U
0004 R 003416 UAO      0004 R 003512 VEL      0003 R 003423 WDOTG      0004 R 006265 W1      0004 R 004750 WNOZ
0004 R 006253 W0      0004 R 006361 WT      0004 R 006246 WTGC

```

```

00101 10 SUBROUTINE CMON (1)
00101 20 C
00103 30 REAL KA, MK, ISP, KAY, ME, MZE, MEX, LAMDA, ISPI
00103 40 C
00104 50 INTEGER CT%, AJ
00104 60 C
00105 70 DIMENSION ICHAM(6,2), AREAT(6), AREAE(6), CV(6,2), CDC(6), THRT(6)
00105 80 C,
00105 90 C, ARINJ(6,2), RGAS(2), THRI(6), ISPI(6), PCI(6), LAMDA(6)
00105 100 C,
00105 110 C, NDEL(20), NPLINE(30), KA(2), WDOTG(30,20), TTEMP(30,20)
00105 120 C, PDROP(6)
00105 130 C, TTEMP(30,20)
00105 140 C
00106 150 COMMON /INDATA/S(5000)
00106 160 C
00107 170 COMMON /COM/AREA(30), DELXL(30), AREAI(30), AREAO(30), AREAK(30)
00107 180 C,
00107 190 C, DIALI(30), PB(6), PG(30,20), RHOG(30,20), NGR(30,2)
00107 200 C,
00107 210 C, NPR(30,2), NRE(30,2), HO(30,2), HI(30,2), THALL(30,2)
00107 220 C,
00107 230 C, HRAD(30,2), UAO(30,2), VEL(30,2), JUN(10), PGT(30,20)
00107 240 C,
00107 250 C, WNOZ(6), MK(6), PC(6), PCN(6,2), CSTAR(6), CONCT(3,6)
00107 260 C,
00107 270 C, PMR(6), TC(6), ISP(6), CF(6), MEX(6), PE(6), MWC(6), LCMON
00107 280 C,
00107 290 C, FRL(30,20), POWC(5), WTGC(5), WO(10), WI(10), OMVENT, PPI(5)
00107 300 C,
00107 310 C, PPO(5), RPMT(5), TTI(5), TIO(5), PTI(5), PTO(5), POAT(5)
00107 320 C,
00107 330 C, POWP(5), CVEL, U, R, ETAT, WT, FBWC(6), FBPC(6)
00107 340 C,
00107 350 C, FBTC(6), TPCL(5), TPCG(5), THOC(5), CGGTC(6), CLTANK(5)
00107 360 C,
00107 370 C, CGTANK(5), CPJU(5,10)
00107 380 C
00110 390 COMMON /CONS/PI, GC, FB
00110 400 C
00111 410 EQUIVALENCE
00111 420 C, (S(65), NDEL(1)), (S(362), IPROP), (S(1804), KA(1))
00111 430 C, (S(364), NPLINE(1)), (S(3018), RGAS(1)), (S(1203), TTEMP(1,1))
00111 440 C, (S(3060), ICHAM(1,1)), (S(3127), AREAT(1)), (S(3154), ARINJ(1,1))
00111 450 C, (S(3139), CV(1,1)), (S(3151), NCOEF), (S(3152), CTW)
00111 460 C, (S(3153), PATH), (S(3190), LAMDA(1)), (S(103), NCHAM)
00111 470 C, (S(3172), ISPI), (S(3178), PCI(1)), (S(1812), WDOTG(1,1))
00111 480 C, (S(3133), AREAE(1)), (S(3166), THRI(1)), (S(3184), CDC(1))
00111 490 C, (S(3212), PDROP(1)), (S(3218), AJ)
00111 500 C, (S(3053), RFLAG)
00111 510 C
00111 520 C, (S(603), TTEMP)
00112 530 II = ICHAM(1,1)
00113 540 IPROP = NPLINE(1)
00114 550 P = PG(11, JJ)
00115 560 T = TTEMP(11, JJ)
00116 570 GO TO (1,2), IPROP
00116 580 C OXYGEN
00117 590 I CPGAS = OPTCP(P, T)
00120 600 CVGAS = OPTCV(P, T)

```

```

00121 49*      GO TO 5
00121 50*      C HYDROGEN
00122 51*      2 CPGAS = HPTCP(P,T)
00123 52*      CVGAS = HPTCV(P,T)
00124 53*      5 KA(IPROP) = CPGAS / CVGAS
00125 54*      RGAS(IPROP) = ( CPGAS - CVGAS ) * 778.156
00126 55*      JJ = NODEL(II)
00127 56*      KAY = KA(IPROP)
00130 57*      IF (ICMON.GE.1) GO TO 40
00132 58*      ICMON = 1
00133 59*      ISAVE = 1
00134 60*      DO 30 I=1,NCHAM
00134 61*      C THRUSTER EXIT MACH NUMBER BASED ON AERA RATIO
00137 62*      E = (KA(IPROP)-1.)*.5
00140 63*      B = (KA(IPROP)+1.0)/(2.0*(KA(IPROP)-1.0))
00141 64*      C = E + 1.
00142 65*      ME = 5.
00143 66*      DO 10 J=1,10
00146 67*      IF (I.GT. 1) ME = MEX(II)
00150 68*      D = (1.+E*ME**2/C)
00151 69*      A = AREAT(II)-AREAT(I)/ME*((1.0+E*ME**2)/C)**.5
00151 70*      C EXIT MACH NUMBER EQ DERIVATIVE
00152 71*      DA = -2.0*E*B*AREAT(II)/C*D**.(B-1.0) + AREAT(II)/ME**2*D**.5
00153 72*      M2E = ME - A/DA
00154 73*      IF (ABS(ME-M2E).LE.1.0E-8.OR.ABS(A).LE.1.0E-8) GO TO 20
00156 74*      ME = M2E
00157 75*      10 CONTINUE
00161 76*      20 MEX(II) = ME
00162 77*      30 CONTINUE
00164 78*      I = ISAVE
00165 79*      40 IF (AJ.EQ.1) GO TO 70
00167 80*      C6 = ARINJ(I,1)*CV(I,1)*SQRT(GC*KAY/(RGAS(II)*TTTEMP(II,JJ)
00167 81*      *2.0/(KAY - 1.0)))
00167 82*      C FIRST GUESS CHAMBER PRESS
00170 83*      PCN(I,1) = 0.9*PGT(II,JJ)
00171 84*      50 CONTINUE
00172 85*      C9 = PCN(I,1)/PGT(II,JJ)
00172 86*      C CV = INJECTOR DISCHARGE COEFFICIENT
00172 87*      C FLOWRATE THRU INJECTOR
00173 88*      C7 = WDOTG(II,JJ) - PGT(II,JJ)*C6*SQRT(C9**.(2.0/KAY) -
00173 89*      1 C9**((KAY+1.0)/KAY))
00174 90*      DCLP = -C6/(2.0*KAY*SQRT(C9**.(2.0/KAY) - C9**((KAY+1.0)/KAY))
00174 91*      * (2.0*C9**.(2.0/KAY-1.0) - (KAY+1.0)*C9**.(1.0/KAY))
00175 92*      DELP = C7/DCLP
00176 93*      PCN(I,1) = PCN(I,1) - DELP
00177 94*      IF (ABS(DELP).LE.1.0E-6) GO TO 60
00201 95*      GO TO 50
00202 96*      60 CONTINUE
00203 97*      GO TO 80
00204 98*      70 CONTINUE
00205 99*      PCN(I,1) = PGT(II,JJ) - PDROP(II)
00206 100*      C9 = PCN(I,1)/PGT(II,JJ)
00207 101*      ARINJ(I,1) = WDOTG(II,JJ)/(PGT(II,JJ)*CV(I,1)*SQRT(GC*KAY*2.0/
00207 102*      1 (RGAS(II)*TTTEMP(II,JJ)*(KAY-1.0))*(C9**.(2.0/KAY)-C9**
00207 103*      2 ((KAY+1.0)/KAY))))
00207 104*      C AREA INJECTOR (FLOW)
00210 105*      80 CONTINUE
00210 106*      C THRUSTER EXIT PRESSURE

```

```

00211 107* PE(I) = PCN(I) / (1.0 + (KA(IPROP)-1.0)*0.5*MEX(I)**2)**(KA(IPROP)
00211 108* /((KA(IPROP)-1.0)))
00211 109* C PGT = TOTAL PRESSURE
00212 110* BB = CDC(I)*AREAT(I)*PCN(I,1)*SQRT(KA(IPROP)/(RGAS(IPROP)*TTTEMP
00212 111* (II,JJ))*(2.0/(KA(IPROP)+1.0))**((KA(IPROP)+1.0)/(KA(IPROP)-1.0)))
00212 112* C CDC = CHAMBER FLOWRATE DISCHARGE COEFFICIENT
00212 113* C C = CONSTANT FOR THRUST EQ
00213 114* C = AREA(I)*(PE(I)*(1.0+LAMDA(I)*KA(IPROP)*MEX(I)**2) - PATH)
00213 115* C LAMDA = DIVERGENCE COEFFICIENT NOZZLE
00213 116* C PATM = ATMOSPHERIC PRESSURE
00214 117* THRT(I) = C
00215 118* CONTINUE
00215 119* C ANOZ = THRUSTER NOZZLE FLOWRATE
00216 120* ANOZ(I) = BB
00217 121* ISP(I) = THRT(I)/ANOZ(I)
00217 122* C THRT = ENGINE THRUST
00220 123* GO TO (120,110,100),CTW
00220 124* C CTW CONSTRAINT EQUATION SWITCH COMBUSTOR (1 = ISP, 2 = PC, 3 = THRUST)
00220 125* C CONSTRAINT EQ THRUST
00221 126* 100 CONCT(I,1) = 1. - C / THRT(I)
00222 127* GO TO 130
00222 128* C CONSTRAINT EQ PC
00223 129* 110 CONCT(I,1) = 1. - PCN(I,1) / PC(I)
00224 130* GO TO 130
00224 131* C CONSTRAINT EQ ISP
00225 132* 120 CONCT(I,1) = 1. - ISP(I) / ISPI(I)
00226 133* 130 IF (RFLAG),150,
00231 134* WRITE(6,140)I,II,JJ,CTW
00231 135* 1, NCHAM,IPROP,ICMON,ICMON
00231 136* 2, KAY,E,B,C
00231 137* 3, ME,D,AREAI(I),AREAT(I)
00231 138* 4, A,DA,C6,ARINJ(I,1)
00231 139* 5, CV(I,1),GC,RGAS(II),TTTEMP(II,JJ)
00231 140* 6, PCN(I,1),PGT(II,JJ),C9,C7
00231 141* 7, ADOTG(II,JJ),DCLP,DELP,PE(I)
00231 142* 8, BB,CDC(I),PATM,LAMDA(I)
00231 143* 9, MEX(I),THRT(I),ANOZ(I),ISP(I)
00231 144* 0, CONCT(I,1)
00304 145* 140 FORMAT(/24X12HCOMMON ROUTINE/7X4I17/7X4I17/(7X1P4E17.7))
00305 146* 150 RETURN
00306 147* END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION. 0 *DIAGNOSTIC* MESSAGE(S)

CMON	CODE	SYMBOLIC	RELOCATABLE	30 JUN 71	20:46:25	0	01723036	14	147	(DELETED)
CMON				30 JUN 71	20:46:25	1	01727050	36	1	(DELETED)
						0	01727114	14	68	

@ HDG @ FOR, * C*ALL,C*ALL

@ FOR,* C*ALL,C*ALL

DATE 310871 PAGE 130

@ FOR,* C*ALL,C*ALL
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:01

31 AUG 71

9127: 1.109

SUBROUTINE C*ALL ENTRY POINT 000012

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000016
0000 *DATA 000010
0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

71
00101 1* SUBROUTINE C*ALL(T,K)
00101 2* CC
00101 3* CC
00101 4* CC THIS SUBROUTINE COMPUTES THE THERMAL
00101 5* CC CONDUCTIVITY OF AISI 347 STAINLESS IN
00101 6* CC BTU/IN-SEC-DEG R
00101 7* C $K = (0.0546 \cdot T + 72.8) / 3600.0 / 144.0$
00103 8* REAL K
00104 9* K $= 1.05324074E-7 \cdot T + 1.40432099E-4$
00105 10* RETURN
00106 11* END

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

C*ALL SYMBOLIC
C*ALL CODE RELOCATABLE

30 APR 71 11:19:10
30 APR 71 11:19:10

0 01457344 14
1 01457576 24
0 01457626 14

11 (DELETED)
1 (DELETED)
3

@ HDG @ FOR,* DP2R,DP2R

@ FOR, DP2R,DP2R
 UNIVAC 1108 FORTRAN V LEVEL 2206 GC18 FS018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:02

31 AUG 71

9:27: 2. 91

FUNCTION DP2R ENTRY POINT 000011

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000013
 0000 *DATA 000007
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000 R 000000 DP2R

00101 1* FUNCTION DP2R(X)
 00101 2* C.....
 00103 3* DOUBLE PRECISION
 00103 4* * X
 00103 5* C.....
 00104 6* DP2R = SNGL(X)
 00105 7* RETURN
 00106 8* END

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

DP2R SYMBOLIC
 DP2R CODE RELOCATABLE

30 APR 71	11:19:11	0	01457700	14	8	(DELETED)
30 APR 71	11:19:11	1	01460060	24	1	(DELETED)
		0	01460110	14	2	

@ HDG @ FOR, DRIVER, DRIVER

3.2.17 DRIVER (OXYGEN PROPERTIES)

@ FOR, DRIVER, DRIVER
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018-F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:03

31 AUG 71

9:27: 3. 69

MAIN PROGRAM

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000206
 0000 *DATA 006071
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 OPTD
 0004 OPTCP
 0005 OPTCV
 0006 NWDUS
 0007 N1015
 0010 N1025
 0011 NSTOPS

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000002	104G	0001	000017	111G	0001	000027	115G	0001	000074	130G	0001	000103	135G
0001	000112	142G	0001	000126	151G	0001	000135	156G	0001	000144	163G	0001	000160	172G
0001	000167	177G	0001	000176	204G	0000	006051	900F	0000	006056	901F	0000	R	002126
0000	R	004076	CV	0000	I	006050	I	0000	I	006047	IP	0000	I	006046
0005	R	000000	OPTCV	0003	R	000000	OPTD	0000	R	000000	P	0000	R	000156
													R	000144
													R	T

00101 1* DIMENSION P(100), T(10), R(10,100), CP(10,100), CV(10,100)
 00103 2* DO 10 IT = 1,10
 00106 3* 10 T(IT) = 50. * FLOAT(IT) + 50.00!
 00110 4* DO 20 IP = 1,100
 00113 5* P(IP) = 10. * FLOAT(IP)
 00114 6* DO 30 IT = 1,10
 00117 7* R (IT,IP) = OPTD (P(IP),T(IT))
 00120 8* CP(IT,IP) = OPTCP(P(IP),T(IT))
 00121 9* CV(IT,IP) = OPTCV(P(IP),T(IT))
 00122 10* 30 CONTINUE
 00124 11* 20 CONTINUE
 00126 12* WRITE (6,900) (T(I),I=1,10)
 00134 13* DO 40 IP=1,100
 00137 14* 40 WRITE(6,901) P(IP), (R (IT,IP), IT=1,10)
 00147 15* WRITE (6,900) (T(I),I=1,10)
 00155 16* DO 41 IP=1,100
 00160 17* 41 WRITE(6,901) P(IP), (CP(IT,IP), IT=1,10)
 00170 18* WRITE (6,900) (T(I),I=1,10)
 00176 19* DO 42 IP=1,100
 00201 20* 42 WRITE(6,901) P(IP), (CV(IT,IP), IT=1,10)

FOR, DRIVER, DRIVER

DATE 310871 133

00211 21° 900 FORMAT (1H1,6X,10F11.0/)
 00212 22° 901 FORMAT (1H,6X,10E11.5)
 00213 23° END

END OF UNIVAC 1108 FORTRAN V COMPILATION.

U *DIAGNOSTIC* MESSAGE(S)

DRIVER SYMBOLIC
 DRIVER CODE RELOCATABLE

26 JUN 71	22:03:52	0	01721726	14	23 (DELETED)
26 JUN 71	22:03:52	1	01722430	24	1 (DELETED)
		0	01722460	14	17

@ HDG @ FOR, FCOMPI, FCOMPI

3.2.18 FCOMP 1 (GAS LINE WITH HEAT TRANSFER AND FRICTION MACH NUMBER CALCULATIONS)

0 FOR, FCOMP1,FCOMP1
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:04

31 AUG 71

9:27: 4.422

SUBROUTINE FCOMP1 ENTRY POINT 000214

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000240
0000 *DATA 000064
0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NWDUS
0004 NIO2S
0005 NERR3S

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000055	1256	0000	000021	30F	0000 R 000003	A	0000 R 000007	AVGM	0000 R 000015	B
0000	R	000016	C	0000	R	000006	D	0000 R 000013	DELXL	0000 R 000014	DIALI
0000	R	000020	FPM2	0000	R	000012	FRL	0000 I 000017	J	0000 R 000002	KA
0000	R	000001	M2P	0000	R	000010	T1	0000 R 000011	T2	0000 R 000004	Z

```

00100 1* C
00101 2* SUBROUTINE FCOMP1(Y,M2,FM2)
00101 3* C
00103 4* REAL M1,M2,M2P,KA
00103 5* C
00104 6* DIMENSION Y(7)
00104 7* C
00104 8* C BUILT IN FUNCTIONS FOR MACH NO. DIFFERENTIAL EQUATION
00105 9* F(ZM2) = M1**2 - ZM2**2 + (2.0*A*Z + Z**2*E + Z**3*D)/(1.0-Z)
00106 10* FP(ZM2) = -2.0*ZM2 + AVGM*((1.0-Z)*(2.0*A+2.0*Z*E+3.0*Z**2*D) +
00106 11* * 2.0*A*Z+Z**2*E+Z**3*D)/(1.0-Z)**2
00106 12* C
00107 13* M1 = Y(1)
00110 14* T1 = Y(2)
00111 15* T2 = Y(3)
00112 16* FRL = Y(4)
00113 17* DELXL = Y(5)
00114 18* DIALI = Y(6)
00115 19* KA = Y(7)
00115 20* C
00116 21* A = (T2-T1)/(T2+T1)
00117 22* B = (48.0*FRL*DELXL)/DIALI
00120 23* C = 0.5*(KA-1.0)
00121 24* D = KA*(2.0*A*C + B*C)
00122 25* E = 2.0*A*C + KA*(2.0*A + B)

```

```

00123 26*      M2      = M 5.0E-3
00123 27*      C
00124 28*      DO 20 J=1,10
00127 29*      AVGM    = 0.5*(M1 + M2)
00130 30*      Z        = AVGM**2
00131 31*      FM2     = F(M2)
00132 32*      FPM2    = FP(M2)
00133 33*      M2P     = M2 - FM2/FPM2
00134 34*      IF (ABS(M2-M2P).LE.1.0E-8.OR.ABS(FM2).LE.1.0E-8) RETURN
00136 35*      M2      = M2P
00137 36*      20 CONTINUE
00137 37*      C
00141 38*      WRITE (6,30)
00143 39*      30 FORMAT (//4X24HNO CONVERGENCE IN FCOMP1 )
00143 40*      C
00144 41*      RETURN
00145 42*      END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

```

FCOMP1      SYMBOLIC
FCOMP1 CODE  RELOCATABLE

```

```

31 AUG 71 09:25:02
31 AUG 71 09:25:02

```

```

0 02110140
1 02111254
0 02111304

```

```

14
24
14

```

```

42 (DELETED)
1 (DELETED)
19

```

FOR, * FCOMP2,FCOMP2

3.2.19 FCOMP 2 (ADIATIC GAS LINE MACH NUMBER CALCULATIONS)

FOR, * FCOMP2, FCOMP2
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:06

31 AUG 71

9:27: 5.878

SUBROUTINE FCOMP2 ENTRY POINT 000136

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000163
0000 *DATA 000051
0002 *BLANK 000000
0003 INDATA 011610

EXTERNAL REFERENCES (BLOCK, NAME)

0004 ALOG
0005 NWDVS
0006 N102s
0007 NERR3s

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000040	1236	0000	000013	30F	0000 R 000001 A	0004 R 000000 ALOG	0000 R 000002 B
0000 R	000006	DIAL1	0000 R	000011	FPG2	0000 R 000003 FRL	0003 I 000551 IPROP	0000 I 000010 J
0003 R	006064	MW	0000 R	000000	PG1	0000 R 000012 PG2P	0003 R 000000 S	0000 R 000005 TTEMP
0000 R	000004	WDOTG	0000 R	000007	XLENG			

00100 1* C
00100 2* C FUNCTION GENERATOR FOR 150TH USING NEWTON-RAPHSON TECHNIQUE
00100 3* C
00101 4* C SUBROUTINE FCOMP2 (X,PG2,FPG2)
00101 5* C
00103 6* C REAL MW
00103 7* C
00104 8* C DIMENSION X(6), MW(2)
00104 9* C
00105 10* C COMMON /INDATA/S(5000)
00105 11* C
00106 12* C EQUIVALENCE
00106 13* C * (S(362),IPROP), (S(3125),MW(1))
00106 14* C
00106 15* C BUILT-IN FUNCTIONS FOR PRESSURE BOUNDARY DIFFERENTIAL EQUATION
00107 16* C $F(2PG2) = ZPG2^{**2} - PG1^{**2} + A*(B-ALOG(ZPG2/PG1))$
00110 17* C $FP(ZPG2) = Z*O*ZPG2 - A/ZPG2$
00110 18* C
00111 19* C PG1 = X(1)
00112 20* C FRL = X(2)
00113 21* C WDOTG = X(3)
00114 22* C TTEMP = X(4)
00115 23* C DIAL1 = X(5)

```

00116 24* XLENGL =
00116 25* C
00117 26* A = 155.695*WDOTG**2*ITEMP/(MW(IPROP)*DIALI**4)
00120 27* B = 24.0*FRL*XLENGL/DIALI
00121 28* PG2 = PG1 - 1.0
00121 29* C
00122 30* DO 20 J=1,10
00125 31* FPG2 = F(PG2)
00126 32* FPPG2 = FP(PG2)
00127 33* PG2P = PG2 - FPG2/FPPG2
00130 34* IF (ABS(PG2-PG2P).LE.1.0E-8.OR.ABS(FPG2).LE.1.0E-8) RETURN
00132 35* PG2 = PG2P
00133 36* 20 CONTINUE
00133 37* C
00135 38* WRITE (6,30)
00137 39* 30 FORMAT (//4X24HNO CONVERGENCE IN FCOMP2 )
00137 40* C
00140 41* RETURN
00141 42* END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(5)

FCOMP2 SYMBOLIC
FCOMP2 CODE RELOCATABLE

31 AUG 71 09:25:03
31 AUG 71 09:25:03

0 02111716
1 02113032
0 02113062

14
24
14

42 (DELETED)
1 (DELETED)
14

@ HDG @ FOR, FCOMP3,FCOMP3

3.2.20. FCOMP 3 (ISOTHERMAL GAS LINE MACH NUMBER CALCULATIONS)

FOR, FCOMP3,FCOMP3
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:07

31 AUG 71

9:27: 7.333

SUBROUTINE FCOMP3 ENTRY POINT 000177

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000224
0000 *DATA 000054
0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 ALOG
0004 NWDUS
0005 NIOZS
0006 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000062	117G	0000	000012	30F	0003 R	000000	ALOG	0000 R	000006	C	0000 R	000005	DIALI
0000 R	000011	FPMZ	0000 R	000003	FRL	0000 R	000007	G	0000 I	000010	J	0000 R	000002	KA
0000 R	000000	M1	0000 R	000001	M2P	0000 R	000004	XLENGL						

```

00101 10 SUBROUTINE FCOMP3 (X,M2,FM2)
00101 20 C
00103 30 REAL M1,M2,M2P,KA
00103 40 C
00104 50 DIMENSION X(5)
00104 60 C
00104 70 C BUILT-IN FUNCTIONS FOR ADIABATIC MACH NO. DIFFERENTIAL EQUATION
00104 80 C
00105 90 F(ZM2) = -48.0*FRL*XLENGL/DIALI + (1.0-M1*M1)/(KA*M1*M1) +
00105 100 C*ALOG((M1*M1*(KA+1.0))/(2.0+M1*M1*(KA-1.0))) +
00105 110 (ZM2**2-1.0)/(KA*ZM2**2) - C*ALOG((ZM2*ZM2*(KA+1.0))/
00105 120 G)
00106 130 FP(ZM2) = 2.0/(KA*ZM2**3) - 4.0*C/(ZM2*G)
00106 140 C
00107 150 M1 = X(1)
00110 160 FRL = X(2)
00111 170 XLENGL = X(3)
00112 180 DIALI = X(4)
00113 190 KA = X(5)
00113 200 C
00114 210 C = (KA+1.0)/(KA*KA)
00115 220 M2 = M1 + 5.0E-3
00115 230 C
00116 240 DO 20 J=1,10
00121 250 G = 2.0 + M2*M2*(KA-1.0)

```



```

00122 26* FM2 = 
00123 27* FPM2 = FPM2
00124 28* M2P = M2 - FPM2/FPM2
00125 29* IF (ABS(M2-M2P).LE.1.0E-8.OR.ABS(FM2).LE.1.0E-8) RETURN
00127 30* M2 = M2P
00130 31* 20 CONTINUE
00130 32* C
00132 33* WRITE (6,30)
00134 34* 30 FORMAT (//4X24HNO CONVERGENCE IN FCOMP3 )
00134 35* C
00135 36* RETURN
00136 37* END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

FCOMP3 SYMBOLIC
FCOMP3 CODE RELOCATABLE

31 AUG 71	09:25:05	0	02113366	14	37	(DELETED)
31 AUG 71	09:25:05	1	02114374	24	1	(DELETED)
		0	02114424	14	18	

8 HDG 8 FOR,* GATHER,GATHER

3.2.21 GATHER (SETS UP PROGRAM STATE VARIABLES, FUNCTION CONSTRAINT
EQUATIONS AND CALLS SYSTEM COMPONENT MODELS)

UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:08

SUBROUTINE GATHER ENTRY POINT 001251

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	001267
0000	*DATA	000227
0002	*BLANK	000000
0003	INDATA	011610
0004	COM	006525

EXTERNAL REFERENCES (BLOCK, NAME)

0005	PBL
0006	PIPL
0007	ADIAB
0010	ISOIH
0011	JUNCL
0012	CHAM
0013	CHON
0014	HEATX
0015	TANKD
0016	TANKC
0017	PIPLL
0020	TURBOP
0021	PREG
0022	VALVG
0023	VALVL
0024	FEEDB
0025	NHDUS
0026	N1015
0027	N1025
0030	NSTOP5
0031	NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000064	10L	0001	000254	100L	0001	000270	102L	0001	000304	103L	0001	000320	104L
0001	000334	105L	0001	000350	106L	0001	000364	107L	0001	000400	108L	0001	000414	109L
0000	000101	110F	0001	000430	111L	0001	000443	120L	0000	000113	130F	0001	000042	131G
0001	000517	140L	0001	000527	150L	0001	000537	160L	0001	000547	170L	0001	000557	180L
0001	000567	190L	0001	000100	20L	0001	000577	200L	0001	000607	210L	0001	000617	220L
0001	000627	230L	0001	000637	240L	0001	000647	242L	0001	000657	243L	0001	000667	244L
0001	000677	249L	0000	000134	250F	0001	000707	251L	0001	000722	260L	0001	000750	270L
0001	000467	271G	0001	000762	280L	0001	000774	290L	0001	001006	292L	0001	001020	293L
0001	001032	294L	0001	001044	295L	0001	001056	296L	0001	001070	297L	0001	001102	298L
0001	001114	299L	0001	000114	30L	0000	000146	300F	0001	001126	301L	0001	000504	302G
0001	001140	302L	0001	001152	303L	0001	001164	304L	0001	001177	310L	0000	000160	320F
0001	000130	40L	0001	000733	417G	0001	000144	50L	0001	001224	534G	0001	000160	60L
0001	000174	70L	0001	000210	80L	0001	000224	90L	0001	000240	91L	0004	R 000000	AREA

0004 R 000074 AREAI	0004 R 000170 AREAK	0004 R 000132 AREAO	0003 R 000606 EAT	0003 R 0006121 ARINJ
0004 R 000060 CF	0004 R 000423 CGGTC	0004 R 000436 CGTANK	0004 R 000431 CLTANK	0004 R 000614 CONCT
0004 R 000443 CPJU	0004 R 000066 CSTAR	0004 R 000355 CVEL	0004 R 000036 DELAL	0004 R 000226 DIALI
0003 R 000510 DIALO	0004 R 000277 DMVENT	0004 R 000360 ETAT	0004 R 000370 FBPC	0004 R 000376 FBTC
0004 R 000362 FBWC	0004 R 000511 FRL	0003 I 010001 FUNCT	0004 R 000132 HI	0004 R 0003036 HO
0003 R 000562 HR	0004 R 000322 HRAO	0000 I 000074 I	0000 I 000024 ICALLS	0004 I 000510 ICMON
0000 I 000050 IFUNCT	0000 I 000000 INDV	0004 I 000502 ISPT	0000 I 000075 IT	0000 I 000077 J
0004 R 000306 JUN	0000 I 000100 K	0003 R 000304 LENGTH	0003 I 000676 M	0003 R 000561 MACH
0004 I 000066 MEX	0004 I 0004736 MR	0004 I 0005102 MWC	0003 I 000677 N	0004 I 000552 NGR
0004 I 0002646 NPR	0004 I 0002742 NRE	0003 I 0004013 NSYS	0003 R 000366 P	0004 R 000264 PB
0004 R 0004764 PC	0003 R 000151 PCI	0004 R 0004772 PCN	0003 R 000644 PDELP	0004 R 0005074 PE
0004 R 000272 PG	0003 R 0004553 PGPBL	0004 R 0003620 PGI	0004 R 0005036 PNR	0004 R 0006241 POWNC
0004 R 000350 PQAP	0004 R 000343 POWT	0004 R 000300 PPI	0004 R 000305 PPO	0003 R 0006721 PRE
0004 R 000331 PTI	0004 R 000336 PTO	0004 R 000357 R	0003 R 0005754 RFLAG	0000 R 000076 RFLAG1
0004 R 000422 RHOQ	0003 R 000316 RI	0003 R 000424 RO	0004 R 000312 RPMT	0003 R 000000 S
0003 I 000541 STATE	0003 I 000065 SYSCOM	0004 R 0005044 TC	0004 R 000416 THOC	0003 R 0006135 THRT
0004 R 000411 TPCG	0004 R 000404 TPCL	0003 R 0001132 TTEMP	0004 R 000317 TTI	0004 R 0006324 TTO
0003 R 000262 TTEMP	0004 R 0003226 TWALL	0004 R 000356 U	0004 R 000416 UAO	0004 R 0003512 VEL
0003 R 0003423 WDTG	0004 R 000265 XI	0004 R 0004750 WNOZ	0004 R 000253 W0	0004 R 0006361 NT
0004 R 000246 WTGC	0003 R 000003 XK			

82

```

00101 10 SUBROUTINE GATHER (X,F,PP,IBLEW)
00101 20 C
00103 30 REAL MACH,JUN,LENGTH
00103 40 C
00104 50 INTEGER SYSCOM,STATE,FUNCT
00104 60 C
00105 70 DIMENSION X(30),F(30),INDV(20),ICALLS(20),IFUNCT(20)
00105 80 C
00106 90 DIMENSION STATE(4,40),FUNCT(2,40),SYSCOM(2,150)
00106 100 , TTEMP(30,20),TTTEMP(30,20),WDTG(30,20),MACH(30,20)
00106 110 , PGPBL(6),DIALO(30),ARINJ(6,2),PCI(6),AREAT(6)
00106 120 , THRT(6),PDELP(5),XK(20),PRE(10),LENGTH(5),RI(5),RO(5)
00106 130 , HR(5),P(5)
00106 140 C
00107 150 COMMON /INDATA/5(5000)
00107 160 C
00110 170 COMMON /COM/AREA(30),DELAL(30),AREAI(30),AREAO(30),AREAK(30)
00110 180 , DIALI(30),PB(6),PG(30,20),RHOQ(30,20),NGR(30,2)
00110 190 , NPR(30,2),NRE(30,2),HO(30,2),HI(30,2),TWALL(30,2)
00110 200 , HRAO(30,2),UAO(30,2),VEL(30,2),JUN(10),PGT(30,20)
00110 210 , WNOZ(6),MR(6),PC(6),PCN(6,2),CSTAR(6),CONCT(18)
00110 220 , PMR(6),TC(6),ISPT(6),CF(6),MEX(6),PE(6),MWC(6),ICMON
00110 230 , FRL(30,20),POWC(5),WTGC(5),WO(10),NI(10),DMVENT,PPI(5)
00110 240 , PPO(5),RPMT(5),TTI(5),TTO(5),PTI(5),PTO(5),POWT(5)
00110 250 , POWP(5),CVEL,U,R,ETAT,RT,FBWC(6),FBPC(6)
00110 260 , FBTC(6),TPCL(5),TPCG(5),THOC(5),CGGTC(6),CLTANK(5)
00110 270 , CGTANK(5),CPJU(50)
00110 280 C
00111 290 EQUIVALENCE
00111 300 * (S(447),M), (S(448),N), (S(3938),STATE(1,1))
00111 310 * (S(603),TTEMP(1,1)), (S(1812),WDTG(1,1)), (S(1203),TTTEMP(1,1))
00111 320 * (S(3154),ARINJ(1,1)), (S(3178),PCI(1)), (S(3127),AREAT(1))
00111 330 * (S(2410),MACH(1,1)), (S(3638),SYSCOM(1,1)), (S(3291),DIALO(1))
00111 340 * (S(3084),NSYS), (S(4098),FUNCT(1,1)), (S(2412),PGPBL(1))

```

```

00111 35*      *, (S(3166), THRT(1))      , (S(421) , PDELP(1))      , (S(3588), XK(1))
00111 36*      *, (S(3538), PRE(1))      , (S(3269), LENGTH(1))      , (S(3279), RI(1))
00111 37*      *, (S(3349), RO(1))      , (S(3443), HK(1))
00111 38*      *, (S(3053), RFLAG)
00111 39*      *, (S(3319), P(1))
00111 40*      C
00112 41*      DATA (INDV(I), I=1, 20)      / 6HWDOTG      , 6HMACH
00112 42*      *,      6HPG      , 6HDIALO
00112 43*      *,      6HTTEMP      , 6HTTEMP
00112 44*      *,      6HPGPBL      , 6HARINJ
00112 45*      *,      6HPCI      , 6HAREAT
00112 46*      *,      6HTHRT      , 6HDIALI
00112 47*      *,      6HPDELP      , 6HXX
00112 48*      *,      6HPRE      , 6HLENGTH
00112 49*      *,      6HRI      , 6HRO
00112 50*      *,      6HHR      , 6HP
00112 51*      C
00114 52*      DATA (ICALLS(I), I=1, 20)      / 6HPBL      , 6HPIPL
00114 53*      *,      6HADIA8      , 6HISOTH
00114 54*      *,      6HJUNCL      , 6HCHAM
00114 55*      *,      6HCMON      , 6HHEATX
00114 56*      *,      6HTANKD      , 6HTANKC
00114 57*      *,      6HPIPLL      , 6HTURBOP
00114 58*      *,      6HPREG      , 6HVALVG
00114 59*      *,      6HVALVL      , 6HFEEOB
00114 60*      *,      6H      , 6H
00114 61*      *,      6H      , 6H
00114 62*      C
00116 63*      DATA (IFUNCT(I), I=1, 20)      / 6HPB      , 6HJUN
00116 64*      *,      6HCONCT      , 6HPDWC
00116 65*      *,      6HWTGC      , 6HFBWC
00116 66*      *,      6HFBPC      , 6HFBTC
00116 67*      *,      6HTPCL      , 6HTPCG
00116 68*      *,      6HTHOC      , 6HCGGTC
00116 69*      *,      6HCLTANK      , 6HCGTANK
00116 70*      *,      6HCPJU      , 6H
00116 71*      *,      6H      , 6H
00116 72*      *,      6H      , 6H
00116 73*      C
00120 74*      DATA IT/=1/
00120 75*      C
00122 76*      IT = IT+1
00123 77*      IF (IT.EQ.0) RFLAG1 = RFLAG
00125 78*      *DIAGNOSTIC* THE TEST FOR EQUALITY BETWEEN NON-INTEGERS MAY NOT BE MEANINGFUL.
00125 79*      IF ((IT.EQ.M+1).AND.(RFLAG1.GT.0.).AND.(RFLAG.EQ.0.)) RFLAG = 1.
00127 80*      C
00127 81*      IBLEW = 0
00127 82*      C
00127 83*      C
00127 84*      SET UP INDEPENDENT VARIABLES
00130 85*      DO 120 I=1, M
00133 86*      J = STATE(2, I)
00134 87*      K = STATE(3, I)
00135 88*      IF (STATE(1, I).NE.INDV(1)) GO TO 10
00137 89*      WDOTG(J, K) = X(I)
00140 90*      GO TO 120
00141 91*      10 IF (STATE(1, I).NE.INDV(2)) GO TO 20
00143 92*      HACH(J, K) = X(I)

```

```

00144 92* GO TO 120
00145 93* 20 IF (STATE(1,1).NE.INDV(3)) GO TO 30
00147 94* PG(J,K) = X(I)
00150 95* GO TO 120
00151 96* 30 IF (STATE(1,1).NE.INDV(4)) GO TO 40
00153 97* DIALO(J) = X(I)
00154 98* GO TO 120
00155 99* 40 IF (STATE(1,1).NE.INDV(5)) GO TO 50
00157 100* TTEMP(J,K) = X(I)
00160 101* GO TO 120
00161 102* 50 IF (STATE(1,1).NE.INDV(6)) GO TO 60
00163 103* TTEMP(J,K) = X(I)
00164 104* GO TO 120
00165 105* 60 IF (STATE(1,1).NE.INDV(7)) GO TO 70
00167 106* PGPBL(J) = X(I)
00170 107* GO TO 120
00171 108* 70 IF (STATE(1,1).NE.INDV(8)) GO TO 80
00173 109* ARINJ(J,K) = X(I)
00174 110* GO TO 120
00175 111* 80 IF (STATE(1,1).NE.INDV(9)) GO TO 90
00177 112* PCI(J) = X(I)
00200 113* GO TO 120
00201 114* 90 IF (STATE(1,1).NE.INDV(10)) GO TO 91
00203 115* AREAT(J) = X(I)
00204 116* GO TO 120
00205 117* 91 IF (STATE(1,1).NE.INDV(11)) GO TO 100
00207 118* THRT(J) = X(I)
00210 119* GO TO 120
00211 120* 100 IF (STATE(1,1).NE.INDV(12)) GO TO 102
00213 121* DIAL1(J) = X(I)
00214 122* GO TO 120
00215 123* 102 IF (STATE(1,1).NE.INDV(13)) GO TO 103
00217 124* POELP(J) = X(I)
00220 125* GO TO 120
00221 126* 103 IF (STATE(1,1).NE.INDV(14)) GO TO 104
00223 127* XK(J) = X(I)
00224 128* GO TO 120
00225 129* 104 IF (STATE(1,1).NE.INDV(15)) GO TO 105
00227 130* PRE(J) = X(I)
00230 131* GO TO 120
00231 132* 105 IF (STATE(1,1).NE.INDV(16)) GO TO 106
00233 133* LENGTH(J) = X(I)
00234 134* GO TO 120
00235 135* 106 IF (STATE(1,1).NE.INDV(17)) GO TO 107
00237 136* RI(J) = X(I)
00240 137* GO TO 120
00241 138* 107 IF (STATE(1,1).NE.INDV(18)) GO TO 108
00243 139* RO(J) = X(I)
00244 140* GO TO 120
00245 141* 108 IF (STATE(1,1).NE.INDV(19)) GO TO 109
00247 142* HR(J) = X(I)
00250 143* GO TO 120
00251 144* 109 IF (STATE(1,1).NE.INDV(20)) GO TO 111
00253 145* P(J) = X(I)
00254 146* GO TO 120
00255 147* 111 CONTINUE
00256 148* WRITE(6,110)STATE(1,1),1
00262 149* 110 FORMAT(//8X4H*** A6,31HIS AN ILLEGAL NAME FOR STATE(1,12,1H))

```

```

00263 150* STOP
00264 151* 120 CONTINUE
00266 152* WRITE(6,130)IT,(STATE(1,1),STATE(2,1),STATE(3,1),X(1),I=1,M)
00300 153* 130 FORMAT (//T25,'ITERATION'14,
00300 154* ' 5X,'GATHER-ROUTINE (INDEPENDENT VARIABLES)')/
00300 155* ' 4(1XA6,1H(12,1H,12,3H) =1PE13,7) )
00300 156* C
00300 157* C SET UP MODEL CALLS
00300 158* C
00301 159* DO 260 I=1,NSYS
00304 160* J = SYSCOM(2,I)
00305 161* IF (SYSCOM(1,1).NE.ICALLS(1)) GO TO 140
00307 162* CALL PBL (J)
00310 163* GO TO 260
00311 164* 140 IF (SYSCOM(1,1).NE.ICALLS(2)) GO TO 150
00313 165* CALL PIPL (J)
00314 166* GO TO 260
00315 167* 150 IF (SYSCOM(1,1).NE.ICALLS(3)) GO TO 160
00317 168* CALL ADIAB (J)
00320 169* GO TO 260
00321 170* 160 IF (SYSCOM(1,1).NE.ICALLS(4)) GO TO 170
00323 171* CALL ISOTH (J)
00324 172* GO TO 260
00325 173* 170 IF (SYSCOM(1,1).NE.ICALLS(5)) GO TO 180
00327 174* CALL JUNC1 (J)
00330 175* GO TO 260
00331 176* 180 IF (SYSCOM(1,1).NE.ICALLS(6)) GO TO 190
00333 177* CALL CHAM (J)
00334 178* GO TO 260
00335 179* 190 IF (SYSCOM(1,1).NE.ICALLS(7)) GO TO 200
00337 180* CALL CMON (J)
00340 181* GO TO 260
00341 182* 200 IF (SYSCOM(1,1).NE.ICALLS(8)) GO TO 210
00343 183* CALL HEATX (J)
00344 184* GO TO 260
00345 185* 210 IF (SYSCOM(1,1).NE.ICALLS(9)) GO TO 220
00347 186* CALL TANKD (J)
00350 187* GO TO 260
00351 188* 220 IF (SYSCOM(1,1).NE.ICALLS(10)) GO TO 230
00353 189* CALL TANKC (J)
00354 190* GO TO 260
00355 191* 230 IF (SYSCOM(1,1).NE.ICALLS(11)) GO TO 240
00357 192* CALL PIPL1 (J)
00360 193* GO TO 260
00361 194* 240 IF (SYSCOM(1,1).NE.ICALLS(12)) GO TO 242
00363 195* CALL TURBOP (J)
00364 196* GO TO 260
00365 197* 242 IF (SYSCOM(1,1).NE.ICALLS(13)) GO TO 243
00367 198* CALL PREG (J)
00370 199* GO TO 260
00371 200* 243 IF (SYSCOM(1,1).NE.ICALLS(14)) GO TO 244
00373 201* CALL VALVG (J)
00374 202* GO TO 260
00375 203* 244 IF (SYSCOM(1,1).NE.ICALLS(15)) GO TO 249
00377 204* CALL VALVL (J)
00400 205* GO TO 260
00401 206* 249 IF (SYSCOM(1,1).NE.ICALLS(16)) GO TO 251
00403 207* CALL FEEDB (J)

```

```

00404 208* GO TO 260
00405 209* 251 CONTINUE
00406 210* WRITE (6,250)SYSCOM(1,1),I
00412 211* 250 FORMAT(/8X4H*** A6,32HIS AN ILLEGAL NAME FOR SYSCOM(1,12,1H))
00413 212* STOP
00414 213* 260 CONTINUE
00414 214* C
00414 215* C SET UP FUNCTIONAL VALUES
00414 216* C
00416 217* DO 310 I=1,N
00421 218* J = FUNCT(2,I)
00422 219* IF (FUNCT(1,I).NE.IFUNCT(1)) GO TO 270
00424 220* F(I) = PB(J)
00425 221* GO TO 310
00426 222* 270 IF (FUNCT(1,I).NE.IFUNCT(2)) GO TO 280
00430 223* F(I) = JUN(J)
00431 224* GO TO 310
00432 225* 280 IF (FUNCT(1,I).NE.IFUNCT(3)) GO TO 290
00434 226* F(I) = CONCT(J)
00435 227* GO TO 310
00436 228* 290 IF (FUNCT(1,I).NE.IFUNCT(4)) GO TO 292
00440 229* F(I) = POWC(J)
00441 230* GO TO 310
00442 231* 292 IF (FUNCT(1,I).NE.IFUNCT(5)) GO TO 293
00444 232* F(I) = HTGC(J)
00445 233* GO TO 310
00446 234* 293 IF (FUNCT(1,I).NE.IFUNCT(6)) GO TO 294
00450 235* F(I) = FBWC(J)
00451 236* GO TO 310
00452 237* 294 IF (FUNCT(1,I).NE.IFUNCT(7)) GO TO 295
00454 238* F(I) = FBPC(J)
00455 239* GO TO 310
00456 240* 295 IF (FUNCT(1,I).NE.IFUNCT(8)) GO TO 296
00460 241* F(I) = FBTC(J)
00461 242* GO TO 310
00462 243* 296 IF (FUNCT(1,I).NE.IFUNCT(9)) GO TO 297
00464 244* F(I) = TPCL(J)
00465 245* GO TO 310
00466 246* 297 IF (FUNCT(1,I).NE.IFUNCT(10)) GO TO 298
00470 247* F(I) = TPCG(J)
00471 248* GO TO 310
00472 249* 298 IF (FUNCT(1,I).NE.IFUNCT(11)) GO TO 299
00474 250* F(I) = THOC(J)
00475 251* GO TO 310
00476 252* 299 IF (FUNCT(1,I).NE.IFUNCT(12)) GO TO 301
00500 253* F(I) = CGGTC(J)
00501 254* GO TO 310
00502 255* 301 IF (FUNCT(1,I).NE.IFUNCT(13)) GO TO 302
00504 256* F(I) = CLTANK(J)
00505 257* GO TO 310
00506 258* 302 IF (FUNCT(1,I).NE.IFUNCT(14)) GO TO 303
00510 259* F(I) = CGTANK(J)
00511 260* GO TO 310
00512 261* 303 IF (FUNCT(1,I).NE.IFUNCT(15)) GO TO 304
00514 262* F(I) = CPJU(J)
00515 263* GO TO 310
00516 264* 304 CONTINUE
00517 265* WRITE (6,300)FUNCT(1,1),I

```

@ FOR,* GATHER,GATHER

DATE 310871 PAGE 146

```

00523 266* 300 FORMAT(/11X4H*** A6,31HIS AN ILLEGAL NAME FOR FUNCT(1,12,1H))
00524 267* STOP
00525 268* 310 CONTINUE
00527 269* RFLAG = RFLAG - 1.
00530 270* IF (RFLAG.LT.0.) RFLAG = 0.
00532 271* WRITE(6,320)(FUNCT(1,1),FUNCT(2,1),F(1),I=1,N)
00542 272* 320 FORMAT(/40X34HGATHER-ROUTINE (FUNCTIONAL VALUES)/
00542 273* * 4(1XA6,1H(12,3H) =1PE13.7) )
00543 274* RETURN
00544 275* END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION. 1 *DIAGNOSTIC* MESSAGE(S)

GATHER	SYMBOLIC	31 AUG 71	09:25:09	0	02115020	14	275	(DELETED)
GATHER	CODE	31 AUG 71	09:25:09	1	02124432	48	1	(DELETED)
				0	02124512	14	84	

@ HDG @ FOR,* HEATEX,HEATEX

FOR, HEATEX, HEATEX
UNIVAC 1108 FORTRAN V LEVEL 2204 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:12

31 AUG 71

9:27:12.492

SUBROUTINE HEATEX ENTRY POINT 002212

STORAGE USED (BLOCK, NAME, LENGTH)

```
0001 *CODE 002333
0000 *DATA 000212
0002 *BLANK 000000
0003 INDATA 011610
0004 HEAT 001074
```

EXTERNAL REFERENCES (BLOCK, NAME)

```
0005 PROPTY
0006 SAT
0007 LATENT
0010 BPROPL
0011 BPROPG
0012 NUSLET
0013 CHALL
0014 SQRT
0015 EXP
0016 NEXP6S
0017 NERR2S
0020 NERR3S
```

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000032 10L	0001 000661 100L	0001 000742 110L	0001 000763 120L	0001 000772 121L
0001 001040 150L	0001 001076 160L	0001 001142 170L	0001 001350 180L	0001 001403 190L
0001 000123 20L	0001 001434 200L	0001 000241 210G	0001 001500 210L	0001 001712 220L
0001 000330 230G	0001 001745 230L	0001 002107 240L	0001 000220 30L	0001 000227 40L
0001 001772 470G	0001 000334 50L	0001 000461 70L	0001 000520 80L	0001 000562 90L
0001 000577 95L	0003 R 000361 ARFL	0000 R 000017 A63662	0000 R 000022 BINR	0000 R 000023 BOUTR
0004 R 000002 CPI	0000 R 000055 CPIA	0000 R 000101 CFIG	0000 R 000075 CPIL	0004 R 000027 CPO
0000 R 000056 CPOA	0000 R 000110 CPOG	0000 R 000105 CPOL	0000 R 000050 CI	0000 R 000051 C2
0000 R 000052 C3	0000 R 000070 DELWT	0003 R 000412 DHYO	0004 R 000054 DIST	0000 R 000064 DPFI
0000 R 000066 OPFO	0000 R 000065 DPMI	0000 R 000067 DPMO	0003 R 000405 OSI	0003 R 000373 OTB
0000 R 000041 OX	0000 R 000073 ENTHG	0000 R 000034 ENTHI	0000 R 000072 ENTHL	0000 R 000035 ENTHO
0000 R 000077 ENTLI	0003 I 000354 FD	0000 R 000060 FFACTI	0000 R 000062 FFACTO	0003 I 000543 FN
0000 R 000021 GC	0004 R 000101 HE	0004 R 000720 HI	0004 R 000772 HO	0004 R 000745 HW
0000 I 000043 I	0000 I 000053 J	0000 I 000040 JB01L	0000 I 000112 JJ	0000 I 000031 JOUT
0000 I 000044 K	0004 R 000126 KI	0000 R 000013 KIG	0000 R 000011 KIL	0004 R 000153 KO
0000 R 000014 KOG	0000 R 000012 KOL	0000 I 000045 KRET	0004 R 000200 KW	0000 R 000002 KI
0000 R 000004 K2	0003 R 000304 LENGTH	0000 I 000026 LS	0003 R 000400 LT	0000 R 000015 MARTI
0000 R 000016 MARTO	0000 R 000003 MUBAR	0004 R 000226 MUI	0000 R 000007 MUIG	0000 R 000005 MUIL
0004 R 000252 MUO	0000 R 000010 MUOG	0000 R 000006 MUOL	0000 I 000024 NSECT	0003 I 000417 NT
0000 R 000000 NUI	0000 R 000001 NUO	0003 R 000366 P	0000 R 000032 PCORI	0000 R 000033 PCORO
0004 R 001071 PH1	0004 R 001072 PH12	0004 R 001073 PH13	0004 R 000277 PI	0000 R 000020 PIE
0004 R 000324 PO	0004 R 000351 PRI	0000 R 000102 PRIG	0000 R 000076 PRIL	0004 R 000376 PRO

```

0000 R 000111 PROG      0000 R 000106 PROL      0004 R 000423 Q      0000 R 000054 QA      0004 R 001017 QUALI
0004 R 001044 QUALO     0004 R 000450 REI      0000 R 000057 RENIN    0000 R 000061 RENOUT   0004 R 000475 REO
0003 R 006316 RI        0003 R 006424 RO      0003 R 000000 S      0000 R 000063 SVBAR   0004 R 000522 SVI
0000 R 000100 SVIG      0000 R 000074 SVIL     0004 R 000547 SVO      0000 R 000107 SVOG   0000 R 000104 SVOL
0000 R 000025 TEMP      0003 R 006323 THICK    0004 R 000574 TI      0004 R 000621 T0      0000 R 000071 TSATI
0000 R 000103 TSA TO    0000 R 000113 TALL     0004 R 000646 TWI     0004 R 000673 TAO      0003 I 006311 TYPE
0000 R 000046 WCI       0000 R 000047 WCO      0004 R 000000 WD      0000 R 000027 WGASI   0000 R 000030 WGASO
0000 R 000036 XI        0000 R 000037 XO      0000 R 000042 XREM

```

68

```

00101 1* SUBROUTINE HEATEX (LN,LI,LO,TI1,T01,TI2,T02,P11,P01,P12,P02,ND1,
00101 2* I WDO,QT,XI1,XO1 )
00101 3* CC THIS SUBROUTINE CALCULATES THE HEAT EXCHANGER OPPOSITE END
00101 4* CC CONDITIONS GIVEN THE FLUID CONDITIONS AT ONE END. FOR
00101 5* CC PARALLEL FLOW HEAT EXCHANGERS, THE OUTLET CONDITIONS ARE
00101 6* CC COMPUTED AS A FUNCTION OF INLET CONDITIONS. FOR COUNTER
00101 7* CC FLOW HEAT EXCHANGERS, THIS SUBROUTINE MUST BE USED IN AN
00101 8* CC ITERATION LOOP. THE HEAT EXCHANGER IS AUTOMATICALLY
00101 9* CC BROKEN 20 SECTIONS.
00101 10* CC LN = HEAT EXCHANGER NUMBER ( 1 = HYDROGEN )
00101 11* CC LO = OUT SIDE FLUID NUMBER ( 2 = OXYGEN )
00101 12* CC LI = IN SIDE FLUID NUMBER ( 3 = H2O-H2, MR=1.0 )
00101 13* CC WD = FLOWRATE (POUNDS/SEC)
00101 14* CC T = TEMPERATURE (DEG R)
00101 15* CC P = PRESSURE (PSIA)
00101 16* CC H = FILM OR WALL CONDUCTIVITY (BTU/54IN SEC DEG R.)
00101 17* CC Q = HEAT TRANSFER FLUX INTO INSIDE FLUID (BTU/SEC IN**2)
00101 18* CC MU = VISCOSITY (POUNDS/IN SEC)
00101 19* CC SV = SPECIFIC VOLUME (CUIN/POUND)
00101 20* CC RE = REYNOLDS NUMBER
00101 21* CC PR = PRANDTL NUMBER
00101 22* CC NU = NUSSLET NUMBER
00101 23* CC TI = INSIDE TEMPERATURE (DEG R)
00101 24* CC T0 = OUTSIDE TEMP (DEG R)
00101 25* CC XI = INSIDE QUALITY
00101 26* CC XO = OUTSIDE QUALITY
00101 27* CC FD = FLAG INPUT HYDRAULIC DIAMETER ( 1 = INPUT DHYO , 0 = CALCULATE
00101 28* CC NT = NUMBER TUBES IN HEAT XER CROSS FLOW
00101 29* CC DHYO = HYDRAULIC DIA FOR CROSS FLOW HELICOIL HEAT XER
00101 30* CC LS = HEAT XER SHELL LENGTH
00101 31* CC DSI = DIAMETER HEAT XER SHELL (INSIDE)
00101 32* CC ARFL = FLOW AREA CROSS SECTION HEAT EX OUTER TUBE
00101 33* CC NT = NUMBER TUBE WRAPS
00101 34* CC DTB = DIAMETER TUBE BUNDLE
00101 35* CC P = PITCH TUBE WRAPS
00101 36* CC LT = LENGTH INNER TUBE
00101 37* CC SUBSCRIPTS (* 1 = INSIDE (CIRCULAR TUBE) *)
00101 38* CC (* 0 = OUTSIDE (ANNULUS) *)
00101 39* CC THE PROGRAM ASSUMES A TUBE INSIDE A CONCENTRIC SHELL, THUS
00101 40* CC CYLINDRICAL PIPE CORRELATIONS ARE USED FOR THE INNER
00101 41* CC PASSAGE, AND ANNULUS CORRELATIONS ARE USED FOR THE OUTER
00101 42* CC PASSAGE WITH THE HYDRAULIC RADIUS BEING USED TO COMPUTE THE
00101 43* CC REYNOLDS NUMBER AND DARCY PRESSURE DROP.
00101 44* CC
00103 45* REAL LT
00103 46* C

```

```

00104 47*   INTEGER TYPE(5),RI(5),RO(5),LENGTH(5),THICK(5),DHYO(5),NT(5)
00104 48*   C
00105 49*   DIMENSION TYPE(5),RI(5),RO(5),LENGTH(5),THICK(5),DHYO(5),NT(5)
00105 50*   *,      FD(5),PI(5),DSI(5),DTB(5),ARFL(5),LT(5)
00105 51*   *,      FN(5)
00105 52*   C
00106 53*   REAL KI,KO,KH,MUI,MUD,LENGTH,NUI,MUD,K1,MUBAK,K2
00107 54*   REAL MUIL,MUOL,MUIG,MUOG,KIL,KOL,KIG,KOG
00110 55*   REAL MARTI,MARTO
00110 56*   C
00111 57*   COMMON /INDATA/ S(5000)
00111 58*   C
00112 59*   COMMON /HEAT/WD(2),CPI(21),CPO(21),DIST(21),HE(21),KI(21),KO(21)
00112 60*   1,      KN(21),MUI(21),MUD(21),PI(21),PO(21),PRI(21),PRO(21)
00112 61*   2,      G(21),REI(21),REO(21),SVI(21),SVO(21),TI(21),TO(21)
00112 62*   3,      TAI(21),TAO(21),HI(21),HW(21),HO(21)
00112 63*   4,      QUALI(21),QUALO(21),PHI1,PHI2,PHI3,
00112 64*   C
00113 65*   EQUIVALENCE
00113 66*   *,(S(3274),TYPE(1)),(S(3279),RI(1)),(S(3349),RO(1))
00113 67*   *,(S(3269),LENGTH(1)),(S(3284),THICK(1)),(S(3339),DHYO(1))
00113 68*   *,(S(3344),NT(1)),(S(3309),FD(1)),(S(3319),PI(1))
00113 69*   *,(S(3334),DSI(1)),(S(3324),DTB(1)),(S(3314),ARFL(1))
00113 70*   *,(S(3329),LT(1)),(S(3428),FN(1))
00113 71*   CC
00114 72*   DATA A63662/0.63662/,PIE,GC/3.14159,386.088/
00114 73*   CC
00114 74*   CC
00114 74*   IMPLICIT REYNOLDS NUMBER FUNCTIONS OF VISCOSITY
00120 75*   RENI(AMU)= BINR/AMU
00121 76*   RENO(AMU)= BOUTR/AMU
00121 77*   C
00122 78*   NSECT = 20
00122 79*   CC
00122 79*   COMPUTE REYNOLDS NUMBER CONSTANTS
00123 80*   BINR= A63662*ABS(WDI)/RI(LN)
00124 81*   TEMP= THICK(LN) + RO(LN)
00125 82*   IF (TYPE(LN).EQ.3) GO TO 10
00127 83*   BOUTR = A63662*ABS(WDO)/(RI(LN)+TEMP)
00127 84*   CC
00127 84*   DHYO = OUTSIDE HYDRAULIC DIAMETER (INCHES)
00127 85*   CC
00127 85*   DHY = 4.0*(FLOW AREA)/(WETTED PERIMETER)
00130 86*   DHYO(LN) = 2.0*(KO(LN)-THICK(LN)-RI(LN))
00131 87*   GO TO 20
00132 88*   10 BOUTR = 2.0*RI(LN)*ABS(WDO)/(ARFL(LN)*NT(LN))
00133 89*   IF (FD(LN).EQ.1) GO TO 20
00135 90*   NT(LN) = LT(LN)/(PIE*DTB(LN) + SQRT(DTB(LN)**2 + P(LN)**2))
00136 91*   LS = NT(LN)*P(LN)
00137 92*   DHYO(LN) = (DSI(LN)**2 - DTB(LN)*8.0*RI(LN)*LT(LN) + DSI(LN)*LS)
00140 93*   20 CONTINUE
00140 94*   CC
00140 95*   CC
00140 95*   PRESSURE DROP TERMS NOT VARYING ALONG TUBE LENGTH
00141 96*   NGASI=(WDI/(PIE*RI(LN)**2))**2/GC
00142 97*   NGASO=(WDO/(PIE*(RO(LN)**2-(RI(LN)+THICK(LN))**2)))**2/GC
00143 98*   JOUT=6
00144 99*   PCORI = 0.
00145 100*   PCORO = 0.
00146 101*   ENTHI = 0.
00147 102*   ENTHO = 0.
00150 103*   XI = X11
00151 104*   XO = X01

```

```

00152 105*      MARTO = 0.
00153 106*      JBOIL = 0
00154 107*      DIST(1)=0.0
00155 108*      QT=0.0
00156 109*      DX = LENGTH(LN)/FLUAT(NSECT)
00157 110*      XREM= LENGTH(LN)
00160 111*      T1(1)=T11
00161 112*      T0(1)=T01
00162 113*      P1(1)=P11
00163 114*      P0(1)=P01
00163 115*      CC      CHECK FLOWRATE AND COMPUTE REYNOLDS NUMBERS
00164 116*      IF (WDI*WDO) 30,,30
00167 117*      T12=T11
00170 118*      T02=T01
00171 119*      P12=P11
00172 120*      P02=P01
00173 121*      QT=0.0
00174 122*      RETURN
00175 123*      30 CONTINUE
00175 124*      CC      START PASS ONE
00176 125*      I=1
00177 126*      K=1
00177 127*      CC      COMPUTE FLUID PROPERTIES AT END ONE
00200 128*      QUAL1(1) = 0.
00201 129*      QUAL0(1) = 0.
00202 130*      KRET=1
00203 131*      GO TO 150
00204 132*      40 CONTINUE
00204 133*      CC
00209 134*      IF (TYPE(LN).EQ.3) NSECT = 1
00207 135*      DO 130 K=1,NSECT
00212 136*      J=K
00213 137*      QUAL1(K+1) = 0.
00214 138*      QUAL0(K+1) = 0.
00214 139*      CC      REGULA FALSI METHOD USED
00214 140*      CC      FIRST GUESS, ASSUMES CONSTANT COEFFICIENTS
00214 141*      CC      LOCAL HEAT TRANSFER FLUX HAS NOW BEEN ESTIMATED.
00214 142*      CC      USING THE INTEGRAL, ASSUMING THAT THE FLUX IS A FUNCTION OF
00214 143*      CC      INSIDE AND OUTSIDE TEMPERATURE DIFFERENCES ONLY, THE
00214 144*      CC      EXPONENTIAL TEMPERATURE COEF. MAY BE CALCULATED(K1,K2)
00215 145*      AC1=WD1*CP1(1)
00216 146*      WCO=WDO*CP0(1)
00217 147*      C1=AC1+WCO
00220 148*      C2=WCI*T1(1)+WCO*T0(1)
00221 149*      K1=HE(1)*[1.0/hC1+1.0/hC0]*2.0*3.14159*R1(LN)
00222 150*      K2=EXP(-K1*DX)
00222 151*      CC      COMPUTE SECTION OUTLET TEMPERATURES
00223 152*      C3=K2*(T0(1)-T1(1))
00224 153*      T1(I+1)=(C2-WCO*C3)/C1
00225 154*      T0(I+1)=T1(I+1)+C3
00226 155*      I=K+1
00227 156*      DO 60 J=1,7
00227 157*      CC      EVALUATE PROPERTIES AT END SECTION
00232 158*      KRET=2
00233 159*      GO TO 150
00234 160*      50 CONTINUE
00235 161*      WA=0.5*(Q(1)+Q(I-1))*R1(LN)*2.0*PI*E*DX
00236 162*      CP1A=0.5*(CP1(1)+CP1(I-1))

```

```

00237 163* CPOA=0.5*(CPI(I)+CPI(I-1))
00240 164* TI(I)=TI(I-1)+GA/(NDI*CPIA)
00241 165* IF (MARTI.GT.0.) TI(I) = TI(I-1)
00243 166* TO(I)=TO(I-1)-GA/(VDO*CPOA)
00244 167* IF (MARTO.GT.0.) TO(I) = TO(I-1)
00246 168* 60 CONTINUE
00250 169* I=K

00250 170* CC
00250 171* CC COMPUTE OUTLET PROPERTIES AT INLET PRESSURE
00251 172* IF (MARTI.GT.0.) GO TO 70
00253 173* CALL PROPT (LI,PI(I),TI(I+1),SVI(I+1),MUI(I+1),KI(I+1),CPI(I+1),
00253 174* 1 PRI(I+1))
00254 175* 70 IF (MARTO.GT.0.) GO TO 80
00256 176* CALL PROPT (LO,PO(I),TO(I+1),SVO(I+1),MUO(I+1),KO(I+1),CPO(I+1),
00256 177* 1 PRO(I+1))
00257 178* 80 CONTINUE
00257 179* CC
00257 180* CC COMPUTE AVERAGE SECTION REYNOLDS NUMBERS, FRICTION
00257 181* CC FACTORS, FRICTION AND MOMENTUM DELTA P, AND OUTLET PRESSURE.
00257 182* CC 1212.93= PI*G (IN/SEC**2)=32.174*12.*3.1416
00260 183* MUBAR=0.5*(MUI(I+1)+MUI(I))
00261 184* RENIN=RENI(MUBAR)
00262 185* FFACT1=0.316/RENIN**0.25
00263 186* MUBAR=(MUO(I)+MUO(I+1))/2.0
00264 187* RENOUT=RENO(MUBAR)
00265 188* IF (TYPE(LN).EQ.3) GO TO 90
00267 189* FFACTO=0.316/RENOUT**0.25
00270 190* GO TO 95
00271 191* 90 FFACTO = 0.2*RENOUT**(-0.2)/(P(LN)/(2.0*RI(LN)) -1.0)
00272 192* 95 SVBAR=(SVI(I)+SVI(I+1))*0.5
00273 193* DPFI=WGASI*FFACT1*SVBAR*DX/(4.0*RI(LN))
00274 194* DPMI=WGASI*(SVI(I+1)-SVI(I))
00275 195* PI(I+1)=PI(I)-DPFI-DPMI
00276 196* IF (NDI.LT.0.0) PI(I+1)=PI(I)+DPFI-DPMI
00300 197* IF (PCORI.LE.0.) GO TO 100
00302 198* DPFI = 0.
00303 199* DPMI = DPMI*PCORI
00304 200* PI(I+1) = PI(I) - DPMI
00305 201* CALL SAT(LI,PI(I+1),TI(I+1))
00306 202* 100 CONTINUE
00306 203* CC
00306 204* CC FOR FRICTIONAL PRESSURE DROP IN THE ANNULUS, THE
00306 205* CC EQUIVALENT HYDRAULIC DIAMETER MUST BE USED IN THE
00306 206* CC DARCY EQUATION (DH=4.0*RH) WHERE RH= HYDRAULIC RADIUS
00307 207* SVBAR=SVO(I)+SVO(I+1)
00310 208* SVBAR=SVBAR*0.5
00311 209* DPFO = WGASO*FFACTO*SVBAR*DX/(2.0*DHYO(LN))
00312 210* DPMO=WGASO*(SVO(I+1)-SVO(I))
00313 211* PO(I+1)=PO(I)-DPFO-DPMO
00314 212* IF (VDO.LT.0.0) PO(I+1)=PO(I)+DPFO-DPMO
00316 213* IF (PCORO.LE.0.) GO TO 110
00320 214* DPFO = 0.
00321 215* PO(I+1) = PO(I) - DPMO
00322 216* CALL SAT(LO,PO(I+1),TO(I+1))
00323 217* 110 CONTINUE
00323 218* CC
00323 219* CC COMPUTE TOTAL HEAT TRANSFER RATE CONTRIBUTION
00324 220* IF (TYPE(LN).EQ.3) GO TO 120

```

```

00326 2210 I=K+1
00327 2220 DELQT = (Q(I)+Q(I-1))*RI(LN)*DX*PIE
00330 2230 QT=QT+DELQT
00331 2240 GO TO 121
00331 2250 CC HEAT TRANSFER TOTAL FOR CROSS FLOW HEAT XER
00332 2260 120 QT = (Q(I) + Q(I-1))*PIE*RI(LN)*LT(LN)
00333 2270 121 CONTINUE
00334 2280 *DIAGNOSTIC* THE TEST FOR EQUALITY BETWEEN NON-INTEGERS MAY NOT BE MEANINGFUL.
00334 2280 IF (ENTHI .NE. 0.) ENTHI = ENTHI + DELQT/WDI
00336 2290 *DIAGNOSTIC* THE TEST FOR EQUALITY BETWEEN NON-INTEGERS MAY NOT BE MEANINGFUL.
00336 2290 IF (ENTHO .NE. 0.) ENTHO = ENTHO + ABS(DELQT/WD0)
00340 2300 DIST(I)=DIST(I-1)+DX
00341 2310 130 CONTINUE
00343 2320 I=NSECT+1
00344 2330 T12=TI(I)
00345 2340 T02=TO(I)
00346 2350 P12=PI(I)
00347 2360 P02=PO(I)
00350 2370 140 RETURN
00350 2380 CC THE FLUID PROPERTIES, WALL TEMPERATURES, AND
00350 2390 CC LOCAL HEAT TRANSFER COEFFICIENTS ARE
00350 2400 CC COMPUTED HERE AT POINT I.
00351 2410 150 CONTINUE
00352 2420 IF (X1.GT.0.95) GO TO 180
00354 2430 CALL SAT (LI,PI(I),TSATI)
00355 2440 IF (X1.GT.0.) GO TO 160
00357 2450 IF (TSATI.GT.TI(I)) GO TO 180
00361 2460 QUALI(K+1) = XI
00362 2470 160 CONTINUE
00363 2480 IF (JBOIL.EQ.1) GO TO 190
00363 2490 CC
00363 2500 CC IN VAPOR DOME (INNER FLUID)
00365 2510 CALL LATENT ( LI, PI(I), ENTHL, ENTHG )
00366 2520 IF (X1.GT.0.) GO TO 170
00366 2530 CC
00366 2540 CC COMPUTE FIRST ENTHALPY VALUE
00370 2550 CALL BPROPL ( LI,PI(I),TSATI,SVIL,MUIL,KIL,CPIL,PRIL )
00371 2560 ENTLI = ENTHL + CPIL * (TI(I)-TSATI )
00372 2570 170 CONTINUE
00372 2580 CC
00372 2590 CC COMPUTE QUALITY
00373 2600 XI = (ENTHI - ENTHL)/(ENTHG - ENTHL)
00373 2610 CC
00374 2620 IF ( XI.GT. 1. ) XI = 1.
00376 2630 QUALI(K) = XI
00376 2640 CC
00376 2650 CC COMPUTE PROPERTIES FOR SATURATED GAS AND
00376 2660 CC SATURATED LIQUID
00377 2670 CALL BPROPL(LI,PI(I),TSATI,SVIL,MUIL,KIL,CPIL,PRIL)
00400 2680 CALL BPROPL(LI,PI(I),TSATI,SVIG,MUIG,KIG,CPIG,PRIG)
00401 2690 MARTI = (XI/(1.-XI))*0.9*(MUIG/MUIL)*0.1*(SVIG/SVIL)*0.5
00402 2700 SVI(I) = XI*SVIG + (1.-XI)*SVIL
00403 2710 CPI(I) = XI*CPIG + (1.-XI)*CPIL
00404 2720 KI(I) = KIG
00405 2730 MUI(I) = MUIG
00406 2740 PRI(I) = PRIG
00407 2750 PCORI = (1.+MARTI)*0.25*((1.-XI)/XI)*0.75*(MUIL/MUIG)*0.083
00407 2760 I = (SVIL/SVIG)*0.416)*0.24

```

```

00410 277* JBOIL = 1
00411 278* GO TO 170
00411 279* CC FLUID PROPERTIES OUTSIDE DOME
00412 280* 180 CALL PROPTY (LI,PI(I),TI(I),SVI(I),MUI(I),KI(I),CPI(I),PRI(I))
00413 281* MARTI = 0.
00414 282* PCORI = 0.
00415 283* 190 CONTINUE
00416 284* IF (XO.GT.0.95) GO TO 220
00420 285* CALL SAT(LO,PO(I),TSATO)
00421 286* IF (XO.GT.0.) GO TO 200
00423 287* IF (TSATO.GT.TO(I)) GO TO 220
00425 288* 200 CONTINUE
00426 289* IF (JBOIL.EQ.1) GO TO 230
00426 290* CC
00426 291* CC IN VAPOR DOME (OUTER FLUID)
00430 292* CALL LATENT (LO,PO(I),ENTHL,ENTHG)
00431 293* IF (XO.GT.0.) GO TO 210
00431 294* CC
00431 295* CC COMPUTE FIRST ENTHALPY VALUE
00433 296* CALL BPROPL(LO,PO(I),TSATO,SVOL,MUOL,KOL,CPOL,PROL)
00434 297* — ENTHO = ENTHL + CPOL*(TO(I) - TSATO)
00435 298* 210 CONTINUE
00435 299* CC
00435 300* CC COMPUTE QUALITY
00436 301* XO = (ENTHO - ENTHL)/(ENTHG - ENTHL)
00437 302* IF (XO.GT.1.) XO = 1.
00441 303* QUALO(K+1) = XO
00441 304* CC
00442 305* IF (XO.GT.0.99) GO TO 220
00442 306* CC COMPUTE PROPERTIES OF SATURATED GAS AND
00442 307* CC SATURATED LIQUID
00444 308* CALL BPROPL(LO,PO(I),TSATO,SVOL,MUOL,KOL,CPOL,PROL)
00445 309* CALL BPROPG(LO,PO(I),TSATO,SVOL,MUOG,KOG,CPOG,PROG)
00446 310* MARTO = (XO/(1.-XO))*-.9*(MUOG/MUOL)*-.1*(SVOG/SVOL)**.5
00447 311* SVO(I) = XO*SVOG + (1.-XO)*SVOL
00450 312* CPO(I) = XO*CPOG + (1.-XO)*CPOL
00451 313* KO(I) = KOG
00452 314* MUO(I) = MUOG
00453 315* PRO(I) = PROG
00454 316* PCORO = (1.+MARTO**25*((1.-XO)/XO)**.75*(MUOL/MUOG)**.083
00454 317* I = (SVOL/SVOG)**.416)**2.4
00455 318* JBOIL = 1
00456 319* GO TO 230
00457 320* 220 CALL PROPTY (LO,PO(I),TO(I),SVO(I),MUO(I),KO(I),CPO(I),PRO(I))
00460 321* MARTO = 0.
00461 322* PCORO = 0.
00462 323* 230 CONTINUE
00462 324* CC
00462 325* CC INSIDE REYNOLDS NUMBER
00463 326* REI(I)=RENI (MUI(I))
00463 327* CC OUTSIDE REYNOLDS NUMBER (ANNULUS RI,RU)
00464 328* REO(I)=RENO(MUO(I))
00464 329* CC
00464 330* CC NUSSLET NUMBER AND EQUIVALENT HEAT TRANSFER COEF DO LOOP
00465 331* TW(I)=0.5*(TI(I)+TO(I))
00466 332* THO(I)=TWI(I)
00466 333* CC ITERATE FOR CORRECT COEFFICIENTS
00467 334* DO 250 JJ=1,3

```

B FOR, HEATEX, HEATEX

DATE 310871 PAGE 154

```

00467 335. CC      COMPUTE NUSSLET NUMBER INSIDE
00472 336.      CALL NUSLET (LI, PRI(1), REI(1), TWI(1), TI(1), MART1, NUI)
00473 337.      HI(1) = NUI * KI(1) / (2.0 * RI(LN))
00473 338. CC
00473 339.      COMPUTE OUTSIDE NUSSLET NUMBER
00474 340.      CALL NUSLET (LO, PRO(1), REQ(1), TWO(1), TO(1), MART2, NUO)
00474 341.      IF (TYPE(LN), NE, 1) GO TO 240
00474 342.      NUO = 0.3 * N(LN) * REO(1) * (NUO * 4) * (PO(1) * NUO * DHYO(LN) / (KOT(1) *
00477 343.      * ASFL(LN) * REO(1) * (-8.8888888E-1)) *
00477 344.      * (TO(1) / TAO(1)) * 0.14 * PHI1 * PHI2 * PHI3
00500 345.      240 HO(1) = NUO * KO(1) / DHYO(LN)
00500 346. CC
00500 347. CC      COMPUTE WALL CONDUCTIVITY
00501 348.      T*ALL = (TWI(1) + TWO(1)) / 2.0
00502 349.      CALL CHALL (T*ALL, KW(1))
00503 350.      HW(1) = KW(1) / THICK(LN)
00503 351. CC      COMPUTE EQUIVALENT HEAT TRANSFER COEF.
00504 352.      HE(1) = 1.0 / (1.0 / HI(1) + 1.0 / HW(1) + 1.0 / HO(1))
00505 353.      Q(1) = (TO(1) - TI(1)) * HE(1)
00506 354.      TWI(1) = TI(1) + Q(1) / HI(1)
00507 355.      TWO(1) = TWI(1) + Q(1) / HW(1)
00510 356.      250 CONTINUE
00512 357.      GO TO (40, 50, 50), KRET
00513 358.      END

```

95

END OF UNIVAC 1108 FORTRAN V COMPILATION.

2 *DIAGNOSTIC* MESSAGE(S)

HEATEX SYMBOLIC
HEATEX CODE RELOCATABLE

14 JUN 71	15:05:32	0	01616672	14	358	(DELETED)
14 JUN 71	15:05:32	1	01630516	36	1	(DELETED)
		0	01630562	14	132	

B HDG B FOR, HEATX, HEATX

FOR, HEATX,HEATX
UNIVAC 1108 FORTRAN V LEVEL 220 18 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:17

HEATX (INTERFACE ROUTINE FOR HEAT EXCHANGER MODEL)

31 AUG 71

7:27:17.405

SUBROUTINE HEATX ENTRY POINT 000404

STORAGE USED (BLOCK, NAME, LENGTH)

0001	•CODE	000422
0000	•DATA	000042
0002	•BLANK	000000
0003	INDATA	011610
0004	CONS	000003
0005	CCPCX	000007
0006	COM	006525

EXTERNAL REFERENCES (BLOCK, NAME)

0007	PERFOR
0010	SQRT
0011	NEKR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000015	10L	0001	000022	20L	0001	000034	21L	0001	000046	22L	0001	000065	30L
0001	000072	40L	0001	000104	41L	0001	000116	42L	0001	000271	43L	0001	000210	44L
0001	000216	50L	0001	000223	60L	0001	000315	70L	0001	000322	80L	0001	000371	81L
0006 R	000000	AREA	0006 R	000674	AREA1	0006 R	000170	AREAK	0006 R	000132	AREAO	0006 R	005060	CF
0006 R	006423	CGGTC	0006 R	006436	CGTANK	0006 R	006431	CLTANK	0006 R	005014	CONCT	0006 R	000000	CPCX
0006 R	006443	CPJU	0006 R	005006	CSTAR	0006 R	006355	CVEL	0006 R	000036	DELXL	0006 R	000226	DIALI
0006 R	006277	DMVENT	0006 R	006360	ETAT	0004 R	000002	FB	0006 R	006370	FBPC	0006 R	006376	FBTC
0006 R	006362	FBWC	0006 R	005111	FRL	0004 R	000001	GC	0003 I	006272	HE11	0003 I	006277	HE10
0003 I	006265	HE01	0003 I	006260	HE00	0003 I	007057	HG11	0003 I	007052	HG01	0006 R	003132	H1
0006 R	003036	HO	0006 R	003322	HRAD	0006 I	005110	ICMON	0005 I	000006	ICK	0000 I	000005	I1
0000 I	000021	IPROP	0006 I	005052	ISPT	0000 I	000006	JJ	0006 I	003606	JUN	0003 R	003413	KA
0003 I	006330	LI	0003 I	006335	LO	0003 R	004561	MACH	0006 I	005066	MEX	0006 I	004756	NR
0006 I	005102	MVC	0006 I	002552	NGR	0003 I	000100	NODEL	0003 I	000553	NPLINE	0006 I	002646	NPR
0006 I	002742	NRE	0006 R	000264	PB	0006 R	004764	PC	0003 R	006151	PCI	0006 R	004772	PCN
0006 R	005074	PE	0006 R	000272	PG	0006 R	003620	P6T	0004 R	000000	PI	0000 R	000014	PIN
0000 R	000017	P12	0006 R	005036	PMR	0000 R	000011	PQUT	0006 R	006241	POWC	0006 R	006350	PQHP
0006 R	006343	PQWT	0000 R	000015	PQ2	0006 R	006300	PPI	0006 R	006305	PPO	0000 R	000022	PROP
0006 R	006331	PT1	0006 R	006336	PTO	0000 R	000000	QT	0006 R	006357	R	0003 R	005711	RGAS
0006 R	001422	RHOG	0006 R	006312	RPMT	0003 R	000000	S	0006 R	005044	TC	0003 R	006656	THEC
0006 R	006416	THOC	0000 R	005013	TIN	0000 R	000020	T12	0000 R	000010	TOUT	0000 R	000016	T02
0006 R	006411	TPCG	0006 R	006404	TPCL	0003 R	001132	TTEMP	0006 R	006317	TI1	0006 R	006324	TTO
0006 R	003226	TWALL	0003 I	006311	TYPE	0006 R	006356	U	0006 R	003416	UAO	0006 R	003512	VEL
0000 R	000012	W01	0000 R	000007	W00	0003 R	003423	W00TG	0006 R	006265	W1	0006 R	004750	WNOZ
0006 R	006253	W0	0006 R	006361	WT	0006 R	006246	WTGC						

96

001n1 1• SUBROUTINE HEATX (1)

97

```

00101 20 C
00101 30 CC DRIVER SUBROUTINE FOR HEAT EXCHANGER MODEL - SETS UP LINE CONNECTS
00101 40 C HE01 = NUMBER OF SYSTEM LIVE CONNECTED TO HEATXER OUTER LIVE INLET
00101 50 C HE00 = NUMBER OF SYSTEM LIVE CONNECTED TO HEATXER OUTER LINE OUTLE
00101 60 C HE11 = NUMBER OF SYSTEM LIVE CONNECTED TO HEATXER INNER LINE INLET
00101 70 C HE10 = NUMBER OF SYSTEM LIVE CONNECTED TO HEATXER INNER LINE OUTLE
00101 80 C
00103 90 INTEGER HE00,HE01,HE11,HE10,HG11,HG01
00103 100 C
00104 110 REAL MACH,KA
00104 120 C
00105 130 DIMENSION HE00(5),HE01(5),HE11(5),HE10(5),NDEL(20),*DOTG(30,20)
00105 140 *, TTEMP(30,20),LI(5),LO(5)
00105 150 *, KA(2),RGAS(2),NPLINE(30)
00105 160 *, MACH(30,20),HG11(5),HG01(5),PCI(5)
00105 170 *, THEC(5)
00105 180 C
00106 190 DIMENSION QT(5)
00106 200 C
00107 210 COMMON /INDATA/ S(5000)
00107 220 C
00110 230 COMMON /CONS/PI,GC,FB
00110 240 C
00111 250 COMMON /CCPCX/ CPCX(6), ICX
00112 260 C
00112 270 COMMON /COM/AREA(30),DETLX(30),AREA1(30),AREAO(30),AREAK(30)
00112 280 *, DIAL1(30),FB(6),PG(30,20),RHOG(30,20),NGR(30,2)
00112 290 *, NPR(30,2),NRE(30,2),HO(30,2),HI(30,2),TWALL(30,2)
00112 300 *, HRAD(30,2),UAO(30,2),VEL(30,2),JUN(10),PGT(30,20)
00112 310 *, HNOZ(6),MR(6),PC(6),PCN(6,2),CSTAR(6),CONCT(3,6)
00112 320 *, PMR(6),TC(6),ISPT(6),CF(6),HEX(6),PE(6),MWC(6),ICMON
00112 330 *, FRL(30,20),POHC(5),WTGC(5),HO(10),WI(10),DMVENT,PPI(5)
00112 340 *, PPO(5),RPHI(5),TTI(5),TTO(5),PTI(5),PTO(5),POWT(5)
00112 350 *, POWP(5),CVEL,U,R,ETAT,WT,FBHC(6),FBPC(6)
00112 360 *, FBTC(6),TPCL(5),TPCG(5),THOC(5),CGGTC(6),CLTANK(5)
00112 370 *, CGTANK(5),CPJU(5,10)
00112 380 C
00113 390 INTEGER TYPE
00113 400 C
00114 410 EQUIVALENCE (S(3274),TYPE)
00115 420 EQUIVALENCE
00115 430 *, (S(65),NDEL(1)), (S(603),TTEMP(1,1)), (S(1812),WDOTG(1,1))
00115 440 *, (S(3249),HE00(1)), (S(3254),HE01(1)), (S(3259),HE11(1))
00115 450 *, (S(3264),HE10(1)), (S(3289),LI(1)), (S(3294),LO(1))
00115 460 *, (S(1804),KA(1)), (S(3018),RGAS(1)), (S(364),NPLINE(1))
00115 470 *, (S(2418),MACH(1,1)), (S(3627),HG01), (S(3632),HG11)
00115 480 *, (S(3178),PCI), (S(3503),THEC(1))
00115 490 C ICX = NUMBER OF COMBUSTOR CONNECTED TO HEAT EXCHANGER H2OH2 ROUTINE
00115 500 C HG11 = NUMBER OF COMBUSTOR CONNECTED TO ITH HEAT EXCHANGER INSIDE LINE
00115 510 C HG01 = NUMBER OF COMBUSTOR CONNECTED TO ITH HEAT EXCHANGER OUTSIDE LINE
00115 520 C
00116 530 II = HE01(1)
00117 540 IF (HG01(1) .GT. 0) GO TO 21
00121 550 IF (II.LE.0) GO TO 10
00123 560 GO TO 20
00124 570 10 II = - II
00125 580 JJ = NDEL(1)
00128 590 20 CONTINUE

```

HEATX,HEATX

```

00127 60* ADD = WDOTG(II,JJ)
00130 61* TOUT = P(II,JJ)
00131 62* POUT = P(II,JJ)
00132 63* GO TO 22
00133 64* 21 CONTINUE
00134 65* ICX = HG01(I)
00135 66* ADD = WNOZ(ICX)
00136 67* TOUT = TC(ICX)
00137 68* POUT = PCI(ICX)
00140 69* 22 CONTINUE
00141 70* II = HE11(I)
00142 71* IF (HG11(I) .GT. 0) GO TO 41
00144 72* IF (II.LE.0) GO TO 30
00146 73* JJ = 1
00147 74* GO TO 40
00150 75* 30 II = - II
00151 76* JJ = NODEL(II)
00152 77* 40 CONTINUE
00153 78* WDI = WDOTG(II,JJ)
00154 79* TIN = TTEMP(II,JJ)
00155 80* PIN = PG(II,JJ)
00156 81* GO TO 42
00157 82* 41 CONTINUE
00160 83* ICX = HG11(I)
00161 84* WDI = WNOZ(ICX)
00162 85* TIN = TC(ICX)
00163 86* PIN = PCI(ICX)
00164 87* 42 CONTINUE
00164 88* C
00165 89* IF (TYPE .EQ. 1) WDI = -WDI
00167 90* CALL PERFOR (TIN,PIN,WDI,WDO,TOUT,POUT,LI(I),LO(I),I
00167 91* , P02,T02,PI2,TI2,GT(I))
00167 92* C
00170 93* IF (TYPE .EQ. 1) WDI = -WDI
00172 94* II = HE00(I)
00173 95* IF (HG01(I) .GT. 0) GO TO 43
00175 96* IF (LO(I) .GE. 3) GO TO 44
00177 97* THOC(I) = 1. - T02 / THEC(I)
00200 98* 44 CONTINUE
00201 99* IF (II) 50,50,
00204 100* JJ = 1
00205 101* GO TO 60
00206 102* 50 II = -II
00207 103* JJ = NODEL(II)
00210 104* 60 CONTINUE
00211 105* IPROP = NPLINE(II)
00212 106* WDOTG(II,JJ) = WDO
00213 107* PG(II,JJ) = P02
00214 108* TTEMP(II,JJ) = T02
00214 109* C DENSITY OF GAS
00215 110* RHOG(II,JJ) = PG(II,JJ)/(RGAS(IPROP)*TTEMP(II,JJ))*144.
00215 111* C MACH NUMBER
00216 112* MACH(II,JJ) = 4.*WDOTG(II,JJ)/(RHOG(II,JJ)*PI*DIALI(II)**2.*SQRT
00216 113* (KA(IPROP)*GC*RGAS(IPROP)*TTEMP(II,JJ)))
00217 114* 43 CONTINUE
00220 115* II = HE10(II)
00221 116* IF (HG11(I) .GT. 0) GO TO 81
00223 117* THOC(II) = 1. - TI2 / THEC(II)

```

6 FOR,* HEATX,HEATX

DATE 310871 PAGE 158

```

00224 118* IF (II.LE.0) GO TO 70
00226 119* JJ = 1
00227 120* GO TO 80
00230 121* 70 II = -II
00231 122* JJ = NODEL(II)
00232 123* 80 CONTINUE
00233 124* PROP = NPLINE(II)
00234 125* WDOTG(II,JJ) = WDI
00235 126* PG(II,JJ) = PIN
00236 127* TTEMP(II,JJ) = TIN
00236 128* C DENSITY OF GAS
00237 129* RHOG(II,JJ) = PG(II,JJ)/(RGAS(IPROP)*TTEMP(II,JJ))*144,
00237 130* C MACH NUMBER
00240 131* MACH(II,JJ) = 4.*WDOTG(II,JJ)/(RHOG(II,JJ)*PI*DIALI(II)**2.*SQRT
00240 132* (KA(IPROP)*GC*RGAS(IPROP)*TTEMP(II,JJ)))
00241 133* 81 CONTINUE
00242 134* ICX = 0
00243 135* RETURN
00244 136* END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

HEATX SYMBOLIC
HEATX CODE RELOCATABLE

30 JUN 71 20:46:39
30 JUN 71 20:46:39

0	01732256	14	136	(DELETED)
1	01736036	36	1	(DELETED)
0	01736102	14	30	

@ HDG @ FOR,* HPTCP,HPTCP

FUNCTION HPTCP ENTRY POINT 000016

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE C00024
 0000 *DATA 000010
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 PTHEAT
 0004 NERR3

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000 R 000000 HPTCP 0003 R 000000 PTHEAT

100

00100	1*	CD	* * * * *	HPTC0010
00100	2*	CD		HPTC0020
00100	3*	CD	PROGRAMMER AND DATE	HPTC0030
00100	4*	CD	J. I. PREWITT	HPTC0040
00100	5*	CD	DECEMBER 1970	HPTC0050
00100	6*	CD		HPTC0060
00100	7*	CD	PURPOSE	HPTC0070
00100	8*	CD	COMPUTES THE SPECIFIC HEAT OF HYDROGEN FOR CONSTANT	HPTC0080
00100	9*	CD	PRESSURE.	HPTC0090
00100	10*	CD		HPTC0100
00100	11*	CD	USAGE	HPTC0110
00100	12*	CD	CP = HPTCP (PRES,TEMP)	HPTC0120
00100	13*	CD		HPTC0130
00100	14*	CD	DESCRIPTION OF PARAMETERS	HPTC0140
00100	15*	CD		HPTC0150
00100	16*	CD	INPUT	HPTC0160
00100	17*	CD	CALLING SEQUENCE	HPTC0170
00100	18*	CD	PRES = PRESSURE = PSIA	HPTC0180
00100	19*	CD	TEMP = TEMPERATURE = O K	HPTC0190
00100	20*	CD		HPTC0200
00100	21*	CD	OUTPUT	HPTC0210
00100	22*	CD	CALLING SEQUENCE	HPTC0220
00100	23*	CD	HPTCP - SPECIFIC HEAT FOR CONSTANT PRESSURE - BTU/LBM/O	HPTC0230
00100	24*	CD		HPTC0240
00100	25*	CD	REMARKS AND RESTRICTIONS	HPTC0250
00100	26*	CD	NONE	HPTC0260
00100	27*	CD		HPTC0270
00100	28*	CD	SUBPROGRAMS REQUIRED	HPTC0280
00100	29*	CD	PTHEAT	HPTC0290

@ FOR,* HPTCP,HPTCP

'DATE 310871 PAGE 160

```

00100 30* CD HPTC0300
00100 31* CD METHOD HPTC0310
00100 32* CD THE SPECIFIC HEAT FOR CONSTANT PRESSURE IS COMPUTED BY HPTC0320
00100 33* CD REFERENCING THE FUNCTION PTHEAT WITH KTRANS EQUAL TO 1. HPTC0330
00100 34* CD HPTC0340
00100 35* CD * * * * * HPTC0350
00101 36* FUNCTION HPTCP (PRES,TEMP) HPTC0360
00103 37* HPTCP = PTHEAT (PRES,TEMP,1) HPTC0370
00104 38* RETURN HPTC0380
00105 39* END HPTC0390

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

D *DIAGNOSTIC*/MESSAGE(S)

HPTCP	SYMBOLIC	14 JUN 71	15:04:57	0	01610054	14	39	(DELETED)
HPTCP	CODE	14 JUN 71	15:04:57	1	01611116	24	1	(DELETED)
	RELOCATABLE			0	01611146	14	3	

@ HDG @ FOR,* HPTCV,HPTCV

& FOR, HPTCV, HPTCV
 UNIVAC 1108 FORTRAN V LEVEL 22 018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:21

FUNCTION HPTCV ENTRY POINT 000016

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000024
 0000 *DATA 000010
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 PTHEAT
 0004 NERRJS

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000 R 000000 HPTCV 0003 R 000000 PTHEAT

102

00100	1*	CD	*****	HPTC0010
00100	2*	CD		HPTC0020
00100	3*	CD	PROGRAMMER AND DATE	HPTC0030
00100	4*	CD	J. I. PREWITT	HPTC0040
00100	5*	CD	DECEMBER 1970	HPTC0050
00100	6*	CD		HPTC0060
00100	7*	CD	PURPOSE	HPTC0070
00100	8*	CD	COMPUTES THE SPECIFIC HEAT OF HYDROGEN FOR CONSTANT	HPTC0080
00100	9*	CD	VOLUME.	HPTC0090
00100	10*	CD		HPTC0100
00100	11*	CD	USAGE	HPTC0110
00100	12*	CD	CV = HPTCV (PRES,TEMP)	HPTC0120
00100	13*	CD		HPTC0130
00100	14*	CD	DESCRIPTION OF PARAMETERS	HPTC0140
00100	15*	CD		HPTC0150
00100	16*	CD	INPUT	HPTC0160
00100	17*	CD	CALLING SEQUENCE	HPTC0170
00100	18*	CD	PRES = PRESSURE - PSIA	HPTC0180
00100	19*	CD	TEMP = TEMPERATURE - O R	HPTC0190
00100	20*	CD		HPTC0200
00100	21*	CD	OUTPUT	HPTC0210
00100	22*	CD	CALLING SEQUENCE	HPTC0220
00100	23*	CD	HPTCV = SPECIFIC HEAT FOR CONSTANT VOLUME - BTU/LBM/O R	HPTC0230
00100	24*	CD		HPTC0240
00100	25*	CD	REMARKS AND RESTRICTIONS	HPTC0250
00100	26*	CD	NONE	HPTC0260
00100	27*	CD		HPTC0270
00100	28*	CD	SUBPROGRAMS REQUIRED	HPTC0280
00100	29*	CD	PTHEAT	HPTC0290

@ FOR,* HPTCV,HPTCV

DATE 310871 PAGE 162

```

00100 30* CD HPTC0300
00100 31* CD METHOD HPTC0310
00100 32* CD THE SPECIFIC HEAT FOR CONSTANT VOLUME IS COMPUTED BY HPTC0320
00100 33* CD REFERENCING THE FUNCTION PTHEAT WITH KTRANS EQUAL TO 2. HPTC0330
00100 34* CD HPTC0340
00100 35* CD * * * * * HPTC0350
00101 36* FUNCTION HPTCV (PRES,TEMP) HPTC0360
00103 37* HPTCV = PTHEAT (PRES,TEMP,2) HPTC0370
00104 38* RETURN HPTC0380
00105 39* END HPTC0390

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

HPTCV	SYMBOLIC	14 JUN 71	15:04:59	0	01611220	14	39	{DELETED}
HPTCV	CODE	14 JUN 71	15:04:59	1	01612262	24	1	{DELETED}
				0	01612312	14	3	

@ HPG @ FOR,* HPTD,HPTD

FOR, * HPTD, HPTD
UNIVAC 1108 FORTRAN V LEVEL 228 018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:22

31 AUG 71

9:27:22.94

FUNCTION HPTD ENTRY POINT 000544

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000551
0000 *DATA 002207
0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR32

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000040	10L	0001	000157	160L	0001	000162	110L	0001	000212	130L	0001	000232	140L
0001	000247	150L	0001	000252	160L	0001	000262	170L	0001	000304	180L	0001	000314	190L
0001	000043	20L	0001	000317	200L	0001	000327	210L	0001	000337	220L	0001	000342	230L
0001	000352	240L	0001	000362	250L	0001	000200	252G	0001	000377	260L	0001	000402	270L
0001	000417	280L	0001	000422	290L	0001	000053	30L	0001	000424	300L	0001	000056	40L
0001	000073	50L	0001	000076	60L	0001	000115	70L	0001	000120	80L	0001	000147	90L
0000 R	000375	AA	0000 R	000545	AB	0000 R	000663	AC	0000 R	001007	AD	0000 R	001157	AE
0000 R	001165	AF	0000 R	001321	AG	0000 R	001467	AH	0000 R	001506	AI	0000 R	001646	AJ
0000 R	001754	AK	0000 R	000542	AZ	0000 R	000175	BP	0000 R	000265	BT	0000 R	000231	DP
0000 R	000321	DT	0000 R	000367	F	0000 R	000372	FF	0000 R	000366	FI	0000 R	000364	FP
0000 R	000370	FT	0000 R	000034	HPTD	0000 I	000362	I	0000 I	000365	IP	0000 I	000371	IT
0000 I	000355	IS	0000 I	000373	J	0000 I	000105	JP	0000 I	000000	LOC	0000 I	000141	MX
0000 I	000360	N	0000 R	000356	P	0000 R	000035	PS	0000 R	000374	PTDENS	0000 R	000375	R
0000 R	000357	T	0000 R	000363	TH	0000 R	000061	TS	0000 R	000361	TZ			

104

00100	1*	CD	*****	HPTD0010
00100	2*	CD		HPTD0020
00100	3*	CD	PROGRAMMER AND DATE	HPTD0030
00100	4*	CD	NATIONAL BUREAU OF STANDARDS	HPTD0040
00100	5*	CD	1967	HPTD0050
00100	6*	CD		HPTD0060
00100	7*	CD	DOCUMENTATION AND DATE	HPTD0070
00100	8*	CD	J. I. PREWITT	HPTD0080
00100	9*	CD	DECEMBER 1970	HPTD0090
00100	10*	CD		HPTD0100
00100	11*	CD	PURPOSE	HPTD0110
00100	12*	CD	COMPUTES THE DENSITY OF HYDROGEN	HPTD0120
00100	13*	CU		HPTD0130
00100	14*	CU	USAGE	HPTD0140
00100	15*	CD	RHO = HPTD (PRES,TEMP)	HPTD0150
00100	16*	CD		HPTD0160
00100	17*	CD	DESCRIPTION OF PARAMETERS	HPTD0170

```

00100 18* CD HPTD0180
00100 19* CD INPUT HPTD0190
00100 20* CD CALLING SEQUENCE HPTD0200
00100 21* CD PRES = PRESSURE = PSIA HPTD0210
00100 22* CD TEMP = TEMPERATURE = O R HPTD0220
00100 23* CD HPTD0230
00100 24* CD HPTD0240
00100 25* CD OUTPUT HPTD0250
00100 26* CD HPTD = DENSITY = LBM/FT**3 HPTD0260
00100 27* CD HPTD0270
00100 28* CD REMARKS AND RESTRICTIONS HPTD0280
00100 29* CD THIS ROUTINES WAS OBTAINED FROM NASA/MSC. HPTD0290
00100 30* CD HPTD0300
00100 31* CD SUBPROGRAMS REQUIRED HPTD0310
00100 32* CD NONE HPTD0320
00100 33* CD HPTD0330
00100 34* CD METHOD HPTD0340
00100 35* CD CHECKS ARE MADE ON PRESSURE AND TEMPERATURE TO OBTAIN HPTD0350
00100 36* CD POINTERS TO A DENSITY TABLE FOR INTERPOLATION. HPTD0360
00100 37* CD THIS ROUTINE WAS OBTAINED FROM NASA/MSC AND IS PART OF HPTD0370
00100 38* CD NBS COMPUTER PROGRAMS FOR THERMODYNAMIC AND TRANSPORT HPTD0380
00100 39* CD PROPERTIES OF HYDROGEN FROM 1 TO 5000 PSIA AND FOR HPTD0390
00100 40* CD TEMPERATURES FROM THE TRIPLE POINT (ABOUT 24.16 O R ) HPTD0400
00100 41* CD TO 5000. O R . AUTHORS ARE W.J.HALL, R.D.MCCARTY AND HPTD0410
00100 42* CD H.M.RODER , NBS REPORT NO 9288 , AUGUST 18, 1967, HPTD0420
00100 43* CD PP 188 , NASA NO N67-35527 HPTD0430
00100 44* CD HPTD0440
00100 45* CD HPTD0450
00101 46* FUNCTION HPTD (PRES,TEMP) HPTD0460
00103 47* DIMENSION PS(20),TS(20),JP(28),MX(28),LOC(28),BP(28),DP(28),BT(28) HPTD0470
00103 48* 1,DT(28),R(865),AA(101),AB(78),AC(84),AD(104),AE(61),AF(92),AG(102),
00103 49* ZAH(15),AI(96),AJ(70),AK(114),AZ(3) HPTD0490
00104 50* EQUIVALENCE (AA,R),(AB,R(105)),(AC,R(183)),(AD,R(267)),(AE,R(371)) HPTD0500
00104 51* 1,(AF,R(377)),(AG,R(469)),(AH,R(571)),(AI,R(586)),(AJ,R(682)),
00104 52* 2(AK,R(752)),(AZ,R(102)) HPTD0520
00105 53* DATA PS/1.022,2.0,4.0,8.0,14.0,25.0,43.0,69.0,99.0,128.0,151.0,165.0,176.0,
00105 54* 1182.0,185.0,186.5,187.25,187.46875,187.506,187.6385/ HPTD0530
00107 55* DATA TS/24.845,27.07,29.81,33.07,36.18,39.96,44.12,48.33,51.97,54. HPTD0550
00107 56* 179.56,72.57,80.58,57.58,99.59,18.59,29.59,34.59,353.59,356.59,4/ HPTD0560
00111 57* DATA LOC/1.23,78.105,141.155,183.201,225.240,267.321,341.377,401. HPTD0570
00111 58* 1 425,437,453,469,494,534,546,586,682,722,752,800,848/ HPTD0580
00113 59* DATA JP/2.5,3.4,2.4,3.4,3.3,3.4,4.4,4.3,3.4,4.5,8.4,5.12,5.3,6.6,6/ HPTD0590
00115 60* DATA MX/0,3,1,2,0,2,1,2,1,1,1,2,2,1,1,2,2,3,6,2,3,10,3,1,4,4,4/ HPTD0600
00117 61* DATA BP/0.0,200.0,-100.0,0.0,0.0,-4.0,0.0,2645.28,1469.6,881.76,0.0,0. HPTD0610
00117 62* 1-44.088,587.84,293.92,73.48,-14.696,293.92,36.74,-7.348,293.92, HPTD0620
00117 63* 2180.0,0.0,29.392,102.872,29.392/ HPTD0630
00121 64* DATA DP/800.0,1200.0,200.0,1000.0,100.0,1000.0,7.0,1000.0,1175.68, HPTD0640
00121 65* 1 587.84,293.92,293.92,293.92,58.784,146.96,146.96,73.48,29.392, HPTD0650
00121 66* 2 73.48,36.74,14.696,73.48,10.0,7.348,14.696,14.696,29.392/ HPTD0660
00123 67* DATA BT/180.0,180.0,500.0,500.0,1300.0,1300.0,2500.0,2500.0,36.0, HPTD0670
00123 68* 1 36.0,27.0,27.0,108.0,108.0,57.6,86.4,86.4,86.4,72.0,72.0,72.0, HPTD0680
00123 69* 2 59.4,59.4,30.0,23.4,39.6,52.2,64.8/ HPTD0690
00125 70* DATA DT/30.0,30.0,100.0,100.0,200.0,200.0,500.0,500.0,36.0,18.0, HPTD0700
00125 71* 1 9.0,9.0,9.0,14.4,7.2,7.2,7.2,7.2,3.6,3.6,7.2,1.8,1.8,6.0,5.4,3.6, HPTD0710
00125 72* 2 1.8,3.6/ HPTD0720
00127 73* DATA AA / 0.0,8376.0,0.7052,0.6114,0.5412,0.4862, HPTD0730
00127 74* 1 0.0,4419.0,4053.0,3746.0,3483.0,3255.0,3056, HPTD0740
00127 75* 2.2652,1.410,2.315,2.924,3.396,2.314,1.179,1.979,2.584,3.052,1.998, HPTD0750

```

00127 76° 31.023,1.739, .09,2.765,.1766,.9058,1.554,2.087,2.526,.1577,.8147,HPTD0070
 00127 77° 41.407,1.905, .025,.1424,.7414,1.286,1.754,2.154,.1297,.6809,1.186,HPTD0070
 00127 78° 51.626,2.008, .1172,.6300,1.102,1.516,1.881,.1101,.5865,1.029,1.421,HPTD0070
 00127 79° 61.769,.1021,.5489,.9656,1.338,1.671,.0953,.5159,.9100,1.264,1.584,HPTD0070
 00127 80° 7.03747,.03747,.11140,.03125,.03125,.09302,.02679,.02679, HPTD0080
 00127 81° 8.07985,.02345,.02345,.06995,.02085,.02085,.06224,.01877, HPTD00810
 00127 82° 9.01877,.05606,.01706,.01706,.05099,.01565,.01565,.04677/ HPTD00820
 00131 83° DATA AZ /-.01445,.01445,.04282/ HPTD00830
 00133 84° DATA AB /,00464,.3605,.6912,.9949,.00341,.3021,.5825,HPTD00840
 00133 85° 1.8432,.00260,.2601,.5038,.7325,.00200,.2285,.4441,.6479, HPTD00850
 00133 86° 2.00161,.2037,.3972,.5810,.00131,.1838,.3592,.5267,.00110, HPTD00860
 00133 87° 3.1674,.3279,.4818,.00090,.15380,.3017,.4439,.00027,.1422,.2793,.41HPTD00870
 00133 88° 416.0,0,.01445,0,0.01252,0,0.01105,0,0.009892,0,0.008951,0,0, HPTD00880
 00133 89° 5.008174,0,.007521,.000267,.1422,.2793,.4116,.000189,.1235,.2432,HPTD00890
 00133 90° 6.3592,.000144,.1092,.2154,.3187,.000120,.09785,.1933,.2864,.000098HPTD00900
 00133 91° 7.08864,.1753,.2601,.000081,.08101,.1604,.2382,.000069,.07459,.147HPTD00910
 00133 92° 88,.2196/ HPTD00920
 00135 93° DATA AC /-.0003009,.0002256,.0007521,-.0002510,.00018HPTD00930
 00135 94° 182,.0006272,-.0002150,.0001611,.0005373,-.0001878,.0001402,.000468HPTD00940
 00135 95° 26,-.0001656,.0001221,.0004119,-.0001452,.0001042,.0003599,.0000069HPTD00950
 00135 96° 3.07459,.1478,.2196,.0000046,.06226,.1236,.1839,.0000031,.05342,.1HPTD00960
 00135 97° 4061,.1582,.0000009,.04677,.09301,.1387,-.0000036,.04155,.08272,.12HPTD00970
 00135 98° 535,-.0000132,.03730,.07436,.1111, 5.270, 5.489, 5.680, 4.501HPTD00980
 00135 99° 6.4845,5.107,3.616,4.126,4.483,2.857,3.466,3.895,2.319,2.935,3.395HPTD00990
 00135 100° 7.4794,5.143,5.270,4.533,4.743,4.886,3.958,4.270,4.501,3.307,3.752HPTD1000
 00135 101° 8.4059,2.698,3.243,3.616,2.226,2.796,3.236,1.886,2.435,2.857,1.639HPTD10010
 00135 102° 9,2.150,2.588,1.453,1.924,2.319/ HPTD10020
 00137 103° DATA AD /5.033,5.112,5.183,4.816,4.910,4.994,4.558,4.4HPTD10030
 00137 104° 1676,4.764,4.248,4.405,4.533,3.880,4.094,4.246,3.442,3.743,3.958,2.4HPTD10040
 00137 105° 2953,3.361,3.633,2.481,2.975,3.307,2.093,2.616,3.002,1.804,2.309,2.4HPTD10050
 00137 106° 3698,1.588,2.059,2.462,1.423,1.856,2.226,1.293,1.691,2.056,1.187,1.1HPTD10060
 00137 107° 4555,1.886,1.100,1.441,1.754,1.026,1.344,1.639,.9627,1.262,1.546,.9HPTD10070
 00137 108° 5076,1.189,1.453, 4.742,4.853,4.946,5.031,4.430,4.584,4.709,4.816HPTD10080
 00137 109° 6.4024,4.279,4.417,4.558,3.165,3.778,4.050,4.248,1.430,2.988,3.595HPTD10090
 00137 110° 7.3880, -.0233,.5581,1.189,1.804,-.015,.5030,1.05,1.588,-.0099,HPTD10100
 00137 111° 84591,.945,1.423,-.0065,.4231,.8618,1.293,-.0042,.3928,.7943,1.187,HPTD10110
 00137 112° 9.0025,.3669,.7379,1.1,-.0015,.3445,.6898,1.026,-.0007,.3249/ HPTD10120
 00141 113° DATA AE /,6483,.9627,-.0001,.3075,.6120,.9076/ HPTD10130
 00143 114° DATA AF /-.07704,.02568,.1307,.2384,-.06786,.02262,1HPTD10140
 00143 115° 1144,.2079,-.06066,.02022,.1018,-.1844,-.05484,.01828,.09179,.1659,-HPTD10150
 00143 116° 2.05004,.01668,.0836,.1508,-.04602,.01534,.07677,.1383, 3.887,3.9HPTD10160
 00143 117° 3864,4.105,3.447,3.446,3.792,2.910,3.226,3.442,2.323,2.760,3.051,1.8HPTD10170
 00143 118° 457,2.317,2.670,1.549,1.963,2.326,1.34,1.701,2.035,1.189,1.497,1.80HPTD10180
 00143 119° 54. .7859,1.309,1.857,.6864,1.106,1.549,.6141,.9689,1.34,.5581,.8HPTD10190
 00143 120° 6735,1.189, .1675,.3524,.5577,.7859,.1530,.3178,.4955,.6864,.1409,HPTD10200
 00143 121° 7.2902,.4479,.6141,.1307,.2674,.4127,.5581, -.03228,.03224,.09858,HPTD10210
 00143 122° 8.1675,-.029742,.02971,.09043,.153,-.027561,.02754,.08359,.1409,-.0HPTD10220
 00143 123° 925680,.02568,.07819,.1307/ HPTD10230
 00145 124° DATA AG /1.226,1.807,2.329,2.674,2.91,1.052,1.481,1.9HPTD10240
 00145 125° 141,2.326,2.616,.9378,1.279,1.656,2.019,2.323,.8526,1.141,1.456,1.7HPTD10250
 00145 126° 274,2.089,.7859,1.047,1.309,1.583,1.857,.09775,.2084,.3279,.461,.6HPTD10260
 00145 127° 3115,.7847,.9864,1.226,.09478, .1962,.3063,.4264,.5585,.7052,.8693,HPTD10270
 00145 128° 41.052,.08981,.1855,.2878,.3977,.5164,.6451,.7851,.9388,.08590,.176HPTD10280
 00145 129° 5.2717,.3734,.4817,.5972,.7207,.8526,.08199,.1675,.2599,.3524,.455HPTD10290
 00145 130° 60,.5577,.6718,.7859, -.019364,.01932,.05888,.09975,-.017558,.0175HPTD10300
 00145 131° 73,.05323,.08981,-.01615,.01611,.04882,.08199, 3.304,3.422,3.541,HPTD10310
 00145 132° 83.659,3.777,3.044,3.290,3.450,3.572,3.667,2.740,3.102,3.304,3.449,HPTD10320
 00145 133° 93.557,2.322,2.880,3.141,3.315,3.447,1.861,2.621,2.959,3.170,3.313/HPTD10330

FOR, HPTD, HPTD DATE 310871 PAGE 166

```

00147 134* DATA AH /1.551,2.329,2.740,3.014,3.179,1.358,2.045, HPTD1340
00147 135* 12.546,2.848,3.044,1.226,1.807,2.329,2.674,2.910/ HPTD1350
00151 136* DATA AI /1.6295,2.42,2.726,2.849,2.937,3.005,3.061,3.1HPTD1360
00151 137* 11.3,153,3.191,3.227,3.259,1.9338,1.076,1.265,1.599,2.202,2.566,2.65HPTD1370
00151 138* 29.2,768,2.85,2.918,2.976,3.026,1.8297,1.9234,1.03,1.159,1.322,1.542,HPTD1380
00151 139* 31.835,2.136,2.356,2.509,2.618,2.709,1.7590,1.8323,1.9121,1.001,1.103,HPTD1390
00151 140* 41.220,1.359,1.523,1.713,1.916,2.106,2.267,1.7053,1.7670,1.8326,1.9039,HPTD1400
00151 141* 5.9807,1.066,1.160,1.265,1.383,1.513,1.655,1.803,1.6621,1.7161,1.7728,HPTD1410
00151 142* 6.8331,1.8976,1.9656,1.040,1.120,1.206,1.299,1.400,1.507,1.6259,1.6745,HPTD1420
00151 143* 7.7250,1.7780,1.8337,1.8927,1.9537,1.019,1.089,1.163,1.242,1.325,1.5941,HPTD1430
00151 144* 8.6412,1.6883,1.7355,1.7824,1.8372,1.8921,1.9469,1.005,1.070,1.135,1.200/HPTD1440
00153 145* DATA AJ/-0.000743,1.04849,1.09854,1.0,1.0,-0.000787,1.04023,1.0HPTD1450
00153 146* 108466,1.1315,1.1715,-0.000437,1.03393,1.07032,1.1097,1.1534,-0.000257,1.029HPTD1460
00153 147* 241,1.06027,1.09278,1.1275,-0.000177,1.02599,1.05289,1.0808,1.1098,-0.000122HPTD1470
00153 148* 3,1.0233,1.0472,1.0717,1.09714,1.000083,1.02112,1.04266,1.06465,1.08719,-0.0HPTD1480
00153 149* 4000065,1.01932,1.03810,1.05888,1.07931, 0,1.01172,1.02363,1.000011,1.00HPTD1490
00153 150* 59736,1.0198,-0.000059,1.008154,1.01648,-0.000036,1.007021,1.01414,-0.00002HPTD1500
00153 151* 64,1.006166,1.0124,-0.000015,1.005498,1.01104,-0.000011,1.004962,1.009954,HPTD1510
00153 152* 7.000009,1.004521,1.009063,-0.000007,1.004153,1.008321,-0.000022,1.003846,HPTD1520
00153 153* 8.007715/ HPTD1530
00155 154* DATA AK/1.1664,1.248,0,0,0,0,0,1.1469,1.2418,1.3397,0,0,0,0,1.1315, HPTD1540
00155 155* 1.2117,1.3091,1.4233,1.5318,0,1.195,1.1891,1.2684,1.3626,1.4811,1.6115, HPTD1550
00155 156* 2.1098,1.1717,1.2400,1.3166,1.4051,1.5124,1.1017,1.1578,1.2183,1.2841,1.3568,HPTD1560
00155 157* 3.4387,1.09486,1.1463,1.2009,1.2592,1.3221,1.3903,1.08892,1.1377,1.1865,1.2407HPTD1570
00155 158* 4,1.295,1.3565,1.5712,1.727,1.9725,0,0,0,0,1.5124,1.6559,1.8514,1.116,0, HPTD1580
00155 159* 50,1.4755,1.5827,1.7329,1.9604,1.252,1.718,1.4387,1.5333,1.6477,1.7994,1.0HPTD1590
00155 160* 668,1.534,1.4145,1.4956,1.5714,1.7060,1.8535,1.1082,1.3903,1.4653,1.5491,1.64HPTD1600
00155 161* 747,1.7575,1.8985,1.3734,1.4399,1.5151,1.5986,1.6928,1.8020,1.3565,1.4161,1.48HPTD1610
00155 162* 898,1.5616,1.6487,1.7358,1.08892,1.1865,1.295,1.4181,1.5616,1.7358,1.08373,1.1HPTD1620
00155 163* 9743,1.2731,1.3822,1.5044,1.6439,1.07931,1.1649,1.2562,1.3545,1.4610,1.5814/HPTD1630
00157 164* P=PRES HPTD1640
00160 165* IF (P.LT.1.0) P=1.0 HPTD1650
00162 166* T=TEMP HPTD1660
00163 167* IF (T.LT.180.0) GO TO 80 HPTD1670
00165 168* IF (T.GE.1300.0) GO TO 40 HPTD1680
00167 169* IF (T.GE.490.0) GO TO 20 HPTD1690
00171 170* IF (P.GE.800.1) GO TO 10 HPTD1700
00173 171* N=1 HPTD1710
00174 172* GO TO 300 HPTD1720
00175 173* 10 N=2 HPTD1730
00176 174* GO TO 300 HPTD1740
00177 175* 20 IF (P.GE.300.0) GO TO 30 HPTD1750
00201 176* N=3 HPTD1760
00202 177* GO TO 300 HPTD1770
00203 178* 30 N=4 HPTD1780
00204 179* GO TO 300 HPTD1790
00205 180* 40 IF (T.GE.2500.0) GO TO 60 HPTD1800
00207 181* IF (P.GE.100.0) GO TO 50 HPTD1810
00211 182* N=5 HPTD1820
00212 183* GO TO 300 HPTD1830
00213 184* 50 N=6 HPTD1840
00214 185* GO TO 300 HPTD1850
00215 186* 60 IF (T.GE.5000.0) T=4999.99999 HPTD1860
00217 187* IF (P.GE.10.0) GO TO 70 HPTD1870
00221 188* N=7 HPTD1880
00222 189* GO TO 300 HPTD1890
00223 190* 70 N=8 HPTD1900
00224 191* GO TO 300 HPTD1910

```

00225	192*	80	TZ=24.84+0.017*P	HPTD1920
00226	193*		IF (T.LT.TZ)	HPTD1930
00230	194*		IF (P.LT.881.0) GO TO 110	HPTD1940
00232	195*		IF (P.LT.2645.28) GO TO 90	HPTD1950
00234	196*		N=9	HPTD1960
00235	197*		GO TO 300	HPTD1970
00236	198*	90	IF (P.LT.1469.6) GO TO 100	HPTD1980
00240	199*		N=10	HPTD1990
00241	200*		GO TO 300	HPTD2000
00242	201*	100	N=11	HPTD2010
00243	202*		GO TO 300	HPTD2020
00244	203*	110	IF (T.GE.59.4) GO TO 140	HPTD2030
00246	204*		N=12	HPTD2040
00247	205*		IF (P.GE.187.6385) GO TO 300	HPTD2050
00251	206*		DO 120 I=2,20	HPTD2060
00254	207*		IF (P-PS(I)).130,130,120	HPTD2070
00257	208*	120	CONTINUE	HPTD2080
00261	209*		I=20	HPTD2090
00262	210*	130	TM=TS(I-1)+(TS(I)-TS(I-1))*(P-PS(I-1))/(PS(I)-PS(I-1))	HPTD2100
00263	211*		IF (T.GE.TM) GO TO 240	HPTD2110
00265	212*		GO TO 300	HPTD2120
00266	213*	140	IF (T.LT.108.0) GO TO 160	HPTD2130
00270	214*		IF (P.LT.132.264) GO TO 150	HPTD2140
00272	215*		N=13	HPTD2150
00273	216*		GO TO 300	HPTD2160
00274	217*	150	N=14	HPTD2170
00275	218*		GO TO 300	HPTD2180
00276	219*	160	IF (P.LT.587.84) GO TO 170	HPTD2190
00300	220*		N=15	HPTD2200
00301	221*		GO TO 300	HPTD2210
00302	222*	170	IF (T.LT.72.0) GO TO 230	HPTD2220
00304	223*		IF (T.LT.86.4) GO TO 200	HPTD2230
00306	224*		IF (P.LT.293.92) GO TO 180	HPTD2240
00310	225*		N=16	HPTD2250
00311	226*		GO TO 300	HPTD2260
00312	227*	180	IF (P.LT.73.48) GO TO 190	HPTD2270
00314	228*		N=17	HPTD2280
00315	229*		GO TO 300	HPTD2290
00316	230*	190	N=18	HPTD2300
00317	231*		GO TO 300	HPTD2310
00320	232*	200	IF (P.LT.293.92) GO TO 210	HPTD2320
00322	233*		N=19	HPTD2330
00323	234*		GO TO 300	HPTD2340
00324	235*	210	IF (P.LT.36.74) GO TO 220	HPTD2350
00326	236*		N=20	HPTD2360
00327	237*		GO TO 300	HPTD2370
00330	238*	220	N=21	HPTD2380
00331	239*		GO TO 300	HPTD2390
00332	240*	230	IF (P.LT.293.92) GO TO 240	HPTD2400
00334	241*		N=22	HPTD2410
00335	242*		GO TO 300	HPTD2420
00336	243*	240	IF (P.LT.180.0) GO TO 250	HPTD2430
00340	244*		N=23	HPTD2440
00341	245*		GO TO 300	HPTD2450
00342	246*	250	IF (P.GE.29.0) GO TO 270	HPTD2460
00344	247*		IF (P.LT.2.9392) GO TO 260	HPTD2470
00346	248*		N=24	HPTD2480
00347	249*		GO TO 300	HPTD2490

FOR, HPTD,HPTD

DATE 310871 PAGE 168

```

00350 250* 260 N=25 HPTD2500
00351 251* GO TO 300 HPTD2510
00352 252* 270 IF (T.GE.64.8) GO TO 290 HPTD2520
00354 253* IF (P.GE.102.0) GO TO 280 HPTD2530
00356 254* N=26 HPTD2540
00357 255* GO TO 300 HPTD2550
00360 256* 280 N=27 HPTD2560
00361 257* GO TO 300 HPTD2570
00362 258* 290 N=28 HPTD2580
00363 259* 300 FP=(P-BP(N))/DP(N) HPTD2590
00364 260* IP=FP HPTD2600
00365 261* IF (IP.GT.MX(N)) IP=MX(N) HPTD2610
00367 262* FI=IP HPTD2620
00370 263* F=FP-FI HPTD2630
00371 264* FP=1.0-F HPTD2640
00372 265* FT=(T-BT(N))/DT(N) HPTD2650
00373 266* IT=FT HPTD2660
00374 267* FI=IT HPTD2670
00375 268* FF=FT-FI HPTD2680
00376 269* FT=1.0-FF HPTD2690
00377 270* I=IT*JP(N)+IP+LOC(N) HPTD2700
00400 271* J=I+JP(N) HPTD2710
00401 272* PTDENS=FP*FT*R(I)+F*FT*R(I+1)+FP*FF*R(J)+F*FF*R(J+1) HPTD2720
00402 273* HPTD = PTDENS HPTD2730
00403 274* RETURN HPTD2740
00404 275* END HPTD2750

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

O *DIAGNOSTIC* MESSAGE(S)

HPTD	CODE	SYMBOLIC	RELLOCATABLE	10 MAY 71	12:52:01	0	01550224	14	275	(DELETED)
HPTD				19 MAY 71	02:50:07	1	01527732	24	1	(DELETED)
						0	01527762	14	141	

END FOR, HPTTC,HPTTC

FOR * HPTTC HPTTC
 UNIVAC 1108 FORTRAN V LEVEL 220 118 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:25

31 AUG 71

9:27:25.191

FUNCTION HPTTC ENTRY POINT 000504

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000511
 0000 *DATA 001274
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000033	10L	0001	000157	100L	0001	000171	110L	0001	000215	120L	0001	000225	130L
0001	000230	140L	0001	000240	150L	0001	000254	160L	0001	000266	180L	0001	000272	190L
0001	000036	20L	0001	000305	200L	0001	000315	210L	0001	000325	220L	0001	000342	230L
0001	000354	240L	0001	000363	250L	0001	000414	260L	0001	000446	30L	0001	000256	302G
0001	000067	40L	0001	000103	50L	0001	000111	60L	0001	000125	70L	0001	000141	80L
0001	000147	90L	0000 R	000237	AA	0000 R	000267	AB	0000 R	000325	AC	0000 R	000351	AD
0000 R	000375	AE	0000 R	000407	AF	0000 R	000452	AG	0000 R	000515	AH	0000 R	000533	AI
0000 R	000662	AJ	0000 R	000713	AK	0000 R	000747	AL	0000 R	001035	AM	0000 R	001057	AN
0000 R	001165	AO	0000 R	000124	BP	0000 R	000162	BT	0000 R	000237	C	0000 R	000143	DP
0000 R	000201	DT	0000 R	000225	F	0000 R	000234	FF	0000 R	000231	FI	0000 R	000230	FP
0000 R	000232	FT	0000 R	000017	HPTTC	0000 I	000226	I	0000 I	000224	IP	0000 I	000233	IT
0000 I	000220	IS	0000 I	000235	J	0000 I	000066	JP	0000 I	000000	LOC	0000 I	000105	MX
0000 I	000223	N	0000 R	000221	P	0000 R	000020	PS	0000 R	000236	PTCOND	0000 R	000222	T
0000 R	000043	TS	0000 R	000227	TSAT									

00100	1*	CD	*****	HPTT0010
00100	2*	CD		HPTT0020
00100	3*	CD	PROGRAMMER AND DATE	HPTT0030
00100	4*	CD	NATIONAL BUREAU OF STANDARDS	HPTT0040
00100	5*	CD	1967	HPTT0050
00100	6*	CD		HPTT0060
00100	7*	CD	DOCUMENTATION AND DATE	HPTT0070
00100	8*	CD	J. I. PREWITT	HPTT0080
00100	9*	CD	DECEMBER 1970	HPTT0090
00100	10*	CD		HPTT0100
00100	11*	CD	PURPOSE	HPTT0110
00100	12*	CD	COMPUTES THE THERMAL CONDUCTIVITY OF HYDROGEN.	HPTT0120
00100	13*	CD		HPTT0130
00100	14*	CD	USAGE	HPTT0140
00100	15*	CD	TC = HPTTC (PRES,TEMP)	HPTT0150
00100	16*	CD		HPTT0160
00100	17*	CD	DESCRIPTION OF PARAMETERS	HPTT0170

```

00100 18* CD HPTT0180
00100 19* CD INPUT HPTT0190
00100 20* CD CALLING SEQUENCE HPTT0200
00100 21* CD PRES - PRESSURE - PSIA HPTT0210
00100 22* CD TEMP - TEMPERATURE - O R HPTT0220
00100 23* CD HPTT0230
00100 24* CD OUTPUT HPTT0240
00100 25* CD HPTT0250
00100 26* CD CALLING SEQUENCE HPTT0260
00100 27* CD HPTTC - THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/O R HPTT0270
00100 28* CD REMARKS AND RESTRICTIONS HPTT0280
00100 29* CD THIS ROUTINE WAS OBTAINED FROM NASA/MSC. HPTT0290
00100 30* CD HPTT0300
00100 31* CD SUBPROGRAMS REQUIRED HPTT0310
00100 32* CD NONE HPTT0320
00100 33* CD HPTT0330
00100 34* CD METHOD HPTT0340
00100 35* CD CHECKS ARE MADE ON PRESSURE AND TEMPERATURE TO OBTAIN HPTT0350
00100 36* CD THE POINTERS TO A THERMAL CONDUCTIVITY TABLE FOR HPTT0360
00100 37* CD INTERPOLATION. HPTT0370
00100 38* CD THIS ROUTINE WAS OBTAINED FROM NASA/MSC AND IS PART OF HPTT0380
00100 39* CD NBS COMPUTER PROGRAMS FOR THERMODYNAMIC AND TRANSPORT HPTT0390
00100 40* CD PROPERTIES OF HYDROGEN FROM 1 TO 5000 PSIA AND FOR HPTT0400
00100 41* CD TEMPERATURES FROM THE TRIPLE POINT (ABOUT 24.16 O R ) HPTT0410
00100 42* CD TO 5000 O R . AUTHORS ARE W.J. HALL, R.D. MCCARTY AND HPTT0420
00100 43* CD H.M. RÖDER , NBS REPORT NO 9288 , AUGUST 18, 1967, HPTT0430
00100 44* CD PP 188 , NASA NO N67-35527 HPTT0440
00100 45* CD HPTT0450
00100 46* CD * * * * * HPTT0460
00101 47* FUNCTION HPTTC (PRES,TEMP) HPTT0470
00103 48* DIMENSION PS(19),TS(19),JP(15),MX(15),LOC(15),BP(15),DP(15),BT(15) HPTT0480
00103 49* 1,OT(15),C(502),AA(24),AB(30),AC(20),AD(20),AE(10),AF(35),AG(35), HPTT0490
00103 50* 2AH(14),AI(87),AJ(25),AK(28),AL(54),AM(18),AN(70),AO(32) HPTT0500
00104 51* EQUIVALENCE (AA,C),(AB,C(25)),(AC,C(55)),(AD,C(75)),(AE,C(95)),(AF,HPTT0510
00104 52* 1,C(105)),(AG,C(140)),(AH,C(175)),(AI,C(189)),(AJ,C(276)),(AK,C(301) HPTT0520
00104 53* 21),(AL,C(329)),(AM,C(383)),(AN,C(401)),(AO,C(471)) HPTT0530
00105 54* DATA JP/9.9,4.4,2.5,7.7,7.7,6.3,7.7,2/ HPTT0540
00107 55* DATA MX/4.2,2.2,0.3,5.5,5.5,4.1,5.5,0/ HPTT0550
00111 56* DATA LOC/ 1.6,55.75,95.105,140.175,189.301,329.383,401.471,499/ HPTT0560
00113 57* DATA BP/0.1469,6.0,1469.6,1028.72,440.88,0.0,0.0,0.0,293.92, HPTT0570
00113 58* 1 180.,180.,120./ HPTT0580
00115 59* DATA DP/293.92,1175.68,1000.,1175.68,440.88,146.96,73.48,0.0,0., HPTT0590
00115 60* 1 73.48,36.74,73.48,20.,20.,40./ HPTT0600
00117 61* DATA BT/180.0,180.0,600.0,36.0,36.0,27.0,108.0,1278.0,2700.0,27.0, HPTT0610
00117 62* 127.0,54.0,54.0,72.0,54.0/ HPTT0620
00121 63* DATA DT/72.72,100.36,36.27.18.,1422.,180.,9.,9.,9.,1.8,9., HPTT0630
00121 64* 15.4/ HPTT0640
00123 65* DATA PS/1.022,2.0,4.0,8.0,14.0,25.0,43.0,69.0,99.0,128.0,151.0, HPTT0650
00123 66* 1165.0,176.0,182.0,185.0,186.5,187.25,187.46875,187.506/ HPTT0660
00125 67* DATA TS/24.845,27.07,29.81,33.07,36.18,39.96,44.12,48.33,51.97, HPTT0670
00125 68* 154.79,56.72,57.80,58.57,58.99,59.18,59.29,59.34,59.353,59.356/ HPTT0680
00127 69* DATA AA /0.4476,.05103,.05971,.06618,.07002,.07268, HPTT0690
00127 70* 1 .08216,.08976,.09584,.06661,.07073,.07749,.08378,.08846,.09187, HPTT0700
00127 71* 2 .09955,.10614,.11242,.08118,.08391,.08873,.09380,.09811,.10166/ HPTT0710
00131 72* DATA AB /0.0974,.11446,.11924,.09099,.09289,.09636, HPTT0720
00131 73* 1 .10028,.10389,.10712,.11542,.11959,.12306,.10290,.10435,.10705, HPTT0730
00131 74* 2 .11024,.11335,.11628,.12469,.12906,.13204,.11286,.11403,.11614, HPTT0740
00131 75* 3 .11874,.12142,.12400,.13217,.13699,.14023/ HPTT0750

```


00133	76*	DATA	AC / .12000, .12607, .13342, .13802, .13189, .13648,	HP10760
00133	77*	1	.14298, .14634, .15012, .15582, .16088, .16075, .16394, .16898,	HP10770
00133	78*	2	.17374, .17765, .18212, .18656/	HP10780
00135	79*	DATA	AD / .08390, .10792, .14312, .19133, .07030, .07723,	HP110790
00135	80*	1	.08549, .09975, .06381, .07448, .08030, .08500, .06449, .07597, .08326,	HP110800
00135	81*	2	.08828, .07268, .08216, .08996, .09584/	HP110810
00137	82*	DATA	AE / .07788, .08390, .06616, .07030, .05634, .06381,	HP110820
00137	83*	1	.05980, .06449, .06830, .07268/	HP110830
00141	84*	DATA	AF / .07723, .07929, .08125, .08326, .08727, .06569,	HP110840
00141	85*	1	.06720, .06847, .06960, .07064, .04563, .05197, .05720, .06084, .06323,	HP110850
00141	86*	2	.04431, .04837, .05114, .05383, .05634, .04662, .05100, .05409, .05637,	HP110860
00141	87*	3	.05813, .05150, .05581, .05920, .06182, .06376, .05785, .06400, .06560,	HP110870
00141	88*	4	.06853, .07073/	HP110880
00143	89*	DATA	AG / .02541, .02703, .03016, .03405, .03783, .04141,	HP110890
00143	90*	1	.04431, .02960, .03087, .03331, .03638, .03956, .04268, .04544, .04332,	HP110900
00143	91*	2	.03538, .03738, .03994, .04269, .04545, .04804, .03938, .04029, .04199,	HP110910
00143	92*	3	.04418, .04661, .04909, .05150, .04476, .04633, .04789, .04946, .05103,	HP110920
00143	93*	4	.05320, .05537/	HP110930
00145	94*	DATA	AH / .20567, .20466, .20390, .20380, .20451, .20597,	HP110940
00145	95*	1	.20852, .36298, .35676, .35209, .35139, .35498, .35604, .35622/	HP110950
00147	96*	DATA	AI / .36286, .35682, .35196, .35150, .35488, .35609,	HP110960
00147	97*	1	.35633, .38534, .38148, .37930, .37664, .37543, .37447, .37471, .41170,	HP110970
00147	98*	2	.40783, .40734, .40275, .39671, .39381, .39356, .44602, .43708, .43781,	HP110980
00147	99*	3	.43079, .41919, .41387, .41339, .49582, .47237, .47165, .46174, .44361,	HP110990
00147	100*	4	.43539, .43418, .57270, .51734, .51154, .49752, .47092, .45859, .45642,	HP111000
00147	101*	5	.69382, .57874, .56182, .54103, .50211, .48422, .48059, .88238, .66553,	HP111010
00147	102*	6	.62782, .59567, .53910, .51299, .50670, .1.1669, .79003, .71775, .66723,	HP111020
00147	103*	7	.58382, .54562, .53595, .5755, .76748, .84201, .76199, .63918, .58310,	HP111030
00147	104*	8	.56859, .2.1303, .1.2148, .1.0124, .88043, .70784, .62686, .60582, .2.8357,	HP111040
00147	105*	9	.5482, .1.2428, .1.0555, .79390, .67810, .64813, .3.6746, .1.9802, .1.5455/	HP111050
00151	106*	DATA	AJ / .1.2723, .90124, .7383, .69696, .4.5908, .2.5142, .1.9	HP111060
00151	107*	1301	.1.5474, .1.034, .80937, .75305, .5.5046, .3.1428, .2.3999, .1.8869, .1.1967,	HP111070
00151	108*	2	.89302, .81784, .6.3121, .3.839, .2.9494, .2.2923, .1.3925, .99093, .89254/	HP111080
00153	109*	DATA	AK / .07199, .07268, .07353, .07441, .07531, .07625,	HP111090
00153	110*	1	.07723, .06733, .06845, .06909, .06973, .07037, .07103, .07170, .06447,	HP111100
00153	111*	2	.06517, .06598, .06670, .06736, .06799, .06859, .06143, .06015, .06048,	HP111110
00153	112*	3	.06236, .06371, .06478, .06569/	HP111120
00155	113*	DATA	AL / .00695, .00730, .00000, .00000, .00000, .00000,	HP111130
00155	114*	1	.00906, .01179, .01806, .00000, .00000, .00000, .01115, .01385, .01972,	HP111140
00155	115*	2	.03034, .00000, .00000, .01324, .01504, .01928, .02628, .03868, .04891,	HP111150
00155	116*	3	.01531, .01666, .01961, .02378, .02870, .03405, .01736, .01842, .02064,	HP111160
00155	117*	4	.02370, .02728, .03106, .01939, .02027, .02205, .02446, .02730, .03032,	HP111170
00155	118*	5	.02142, .02216, .02362, .02566, .02796, .03054, .02342, .02406, .02529,	HP111180
00155	119*	6	.02700, .02895, .03113/	HP111190
00157	120*	DATA	AM / .06371, .06478, .06569, .05421, .05850, .06083,	HP111200
00157	121*	1	.04069, .04580, .05134, .03864, .04257, .04563, .03782, .04179, .04456,	HP111210
00157	122*	2	.03760, .04137, .04422/	HP111220
00161	123*	DATA	AN / .06143, .06192, .06235, .06276, .06313, .06348,	HP111230
00161	124*	1	.06380, .05956, .06027, .06088, .06141, .06189, .06233, .06273, .05656,	HP111240
00161	125*	2	.05790, .05888, .05967, .06034, .06092, .06144, .06285, .05321, .05573,	HP111250
00161	126*	3	.05719, .05826, .05912, .06011, .06072, .06138, .06285, .06471, .05282, .05811,	HP111260
00161	127*	4	.05661, .05764, .06334, .06345, .06353, .06401, .06496, .05273, .05457,	HP111270
00161	128*	5	.03257, .03522, .03775, .04027, .04330, .04718, .05016, .03190, .03433,	HP111280
00161	129*	6	.03663, .03878, .04069, .04321, .04569, .04813, .03366, .03582, .03761,	HP111290
00161	130*	7	.03967, .04145, .04328, .03098, .03313, .03517, .03707, .03882, .04043,	HP111300
00161	131*	8	.04199/	HP111310
00163	132*	DATA	AO / .03070, .03277, .03466, .03655, .03818, .03975,	HP111320
00163	133*	1	.04115, .03002, .03169, .03328, .03488, .03634, .03776, .03904, .03028,	HP111330

00163	134*	2	*03167,*03302,*03442,*03576,*03701,*03821,*03091,*03211,*03329,	HPTT1340
00163	135*	3	*03452,*03570,*03684,*03795,*05950,*06088,*05036,*05159/	HPTT1350
00165	136*		P=PRES	HPTT1360
00166	137*		IF (P.LT.1.0) P=1.0	HPTT1370
00170	138*		T=TEMP	HPTT1380
00171	139*		IF (T.LT.180.0) GO TO 110	HPTT1390
00173	140*		IF (T.GE.540.0) GO TO 20	HPTT1400
00175	141*		IF (P.GE.1469.6) GO TO 10	HPTT1410
00177	142*		N=1	HPTT1420
00200	143*		GO TO 250	HPTT1430
00201	144*	10	N=2	HPTT1440
00202	145*		GO TO 250	HPTT1450
00203	146*	20	IF (T.GE.1000.0) GO TO 30	HPTT1460
00205	147*		N=3	HPTT1470
00206	148*		GO TO 250	HPTT1480
00207	149*	30	IF (P.GE.29.392) GO TO 40	HPTT1490
00211	150*		IF (P.LT.14.696) GO TO 40	HPTT1500
00213	151*		IP=2	HPTT1510
00214	152*		F=P/14.696-1.0	HPTT1520
00215	153*		GO TO 90	HPTT1530
00216	154*	40	IF (P.LT.7.368) GO TO 50	HPTT1540
00220	155*		IP=1	HPTT1550
00221	156*		F=P/7.348-1.0	HPTT1560
00222	157*		GO TO 90	HPTT1570
00223	158*	50	IP=0	HPTT1580
00224	159*		F=(P-1.4696)/5.8784	HPTT1590
00225	160*		GO TO 90	HPTT1600
00226	161*	60	IF (P.GE.146.96) GO TO 70	HPTT1610
00230	162*		IP=3	HPTT1620
00231	163*		F=(P-29.392)/117.568	HPTT1630
00232	164*		GO TO 90	HPTT1640
00233	165*	70	IF (P.GE.734.8) GO TO 80	HPTT1650
00235	166*		IP=4	HPTT1660
00236	167*		F=(P-146.96)/587.84	HPTT1670
00237	168*		GO TO 90	HPTT1680
00240	169*	80	IP=5	HPTT1690
00241	170*		F=P/734.8-1.0	HPTT1700
00242	171*	90	IF (T.GT.2700.0) GO TO 100	HPTT1710
00244	172*		N=8	HPTT1720
00245	173*		GO TO 260	HPTT1730
00246	174*	100	N=9	HPTT1740
00247	175*		IF (T.GE.5400.0) T=5399.9999	HPTT1750
00251	176*		GO TO 260	HPTT1760
00252	177*	110	IF (T.LT.20.0) T=20.0	HPTT1770
00254	178*		IF (P.LT.440.88) GO TO 140	HPTT1780
00256	179*		IF (P.LT.1469.6) GO TO 120	HPTT1790
00260	180*		N=4	HPTT1800
00261	181*		GO TO 250	HPTT1810
00262	182*	120	IF (P.LT.1028.72) GO TO 130	HPTT1820
00264	183*		N=5	HPTT1830
00265	184*		GO TO 250	HPTT1840
00266	185*	130	N=6	HPTT1850
00267	186*		GO TO 250	HPTT1860
00270	187*	140	IF (T.LT.99.0) GO TO 150	HPTT1870
00272	188*		N=7	HPTT1880
00273	189*		GO TO 250	HPTT1890
00274	190*	150	IF (T.GE.54.0) GO TO 210	HPTT1900
00276	191*		N=10	HPTT1910

```

00277 192* IF (P.GE.120) GO TO 250
00301 193* 160 DO 170 I=2,1
00304 194* IF (P-PS(I)) ,180,170
00307 195* 170 CONTINUE
00311 196* 180 TSAT=TS(I)
00312 197* GO TO 200
00313 198* 190 TSAT=TS(I-1)+(TS(I)-TS(I-1))*(P-PS(I-1))/(PS(I)-PS(I-1))
00314 199* 200 IF (T.GT.TSAT) N=11
00316 200* GO TO 250
00317 201* 210 IF (P.LT.300.0) GO TO 220
00321 202* N=12
00322 203* GO TO 250
00323 204* 220 IF (T.GE.59.356) GO TO 240
00325 205* IF (P.GE.180.0) GO TO 230
00327 206* N=15
00330 207* GO TO 160
00331 208* 230 N=13
00332 209* IF (T.GE.70.2) N=14
00334 210* GO TO 250
00335 211* 240 IF (P.GE.180.0) GO TO 230
00337 212* N=11
00340 213* 250 FP=(P-BP(N))/DP(N)
00341 214* IP=FP
00342 215* IF (IP.GT.MX(N)) IP=MX(N)
00344 216* FI=IP
00345 217* F=FP-FI
00346 218* 260 FP=1.0-F
00347 219* FI=(T-BT(N))/DT(N)
00350 220* IT=FI
00351 221* FI=IT
00352 222* FF=FI-FI
00353 223* FI=1.0-FF
00354 224* I=IT*JP(N)+IP*LOC(N)
00355 225* J=I+JP(N)
00356 226* PTCND=FP*FT*C(I)+F*FT*C(I+1)+FP*FF*C(J)+F*FF*C(J+1)
00357 227* HPTTC = PTCND
00360 228* RETURN
00361 229* END

```

```

HPTT1950
HPTT1950
HPTT1950
HPTT1960
HPTT1970
HPTT1980
HPTT1990
HPTT2000
HPTT2010
HPTT2020
HPTT2030
HPTT2040
HPTT2050
HPTT2060
HPTT2070
HPTT2080
HPTT2090
HPTT2100
HPTT2110
HPTT2120
HPTT2130
HPTT2140
HPTT2150
HPTT2160
HPTT2170
HPTT2180
HPTT2190
HPTT2200
HPTT2210
HPTT2220
HPTT2230
HPTT2240
HPTT2250
HPTT2260
HPTT2270
HPTT2280
HPTT2290

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

HPTIC SYMBOLIC
HPTIC CODE RELOCATABLE

01 MAR 71 18:48:10 0 01557636 14 229 (DELETED)
30 APR 71 11:19:31 1 01460144 24 1 (DELETED)
0 01460174 14 96

5 HDG 3 FOR, HPTV, HPTV

FOR, HPTV,HPTV
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:28

31 AUG 71

9:27:27.979

FUNCTION HPTV ENTRY POINT 000461

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000466
0000 *DATA 001404
0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR3s

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000026	10L	0001	000147	100L	0001	000157	110L	0001	000162	120L	0001	000210	140L
0001	000214	150L	0001	000227	160L	0001	000237	170L	0001	000247	180L	0001	000257	190L
0001	000043	20L	0001	000267	200L	0001	000277	210L	0001	000307	220L	0001	000324	230L
0001	000327	240L	0001	000337	250L	0001	000341	260L	0001	000200	276G	0001	000053	30L
0001	000056	40L	0001	000075	50L	0001	000105	60L	0001	000110	70L	0001	000131	80L
0001	000144	90L	0000 R	000314	AA	0000 R	000340	A8	0000 R	000360	AC	0000 R	000366	AD
0000 R	000374	AE	0000 R	000444	AF	0000 R	000474	AG	0000 R	000514	AH	0000 R	000541	AI
0000 R	000566	AJ	0000 R	000622	AK	0000 R	000636	AL	0000 R	000730	AM	0000 R	000732	AN
0000 R	000756	AO	0000 R	001006	AP	0000 R	001052	AQ	0000 R	001076	AR	0000 R	001170	AS
0000 R	001172	AT	0000 R	001246	AU	0000 R	001304	AV	0000 R	000150	BP	0000 R	000222	BT
0000 R	000175	DP	0000 R	000247	DT	0000 R	000306	F	0000 R	000311	FF	0000 R	000305	FI
0000 R	000303	FP	0000 R	000307	FT	0000 R	000025	HPTV	0000 I	000301	I	0000 I	000304	IP
0000 I	000310	IT	0000 I	000274	IS	0000 I	000312	J	0000 I	000076	JP	0000 I	000000	LOC
0000 I	000123	MX	0000 I	000277	N	0000 R	000275	P	0000 R	000026	PS	0000 R	000313	PTVISC
0000 R	000276	T	0000 R	000302	TL	0000 R	000052	TS	0000 R	000300	TZ	0000 R	000314	V

00100 1* CD* * * * * HPTV0010
00100 2* CD HPTV0020
00100 3* CD PROGRAMMER AND DATE HPTV0030
00100 4* CD NATIONAL BUREAU OF STANDARDS HPTV0040
00100 5* CD 1967 HPTV0050
00100 6* CD HPTV0060
00100 7* CD DOCUMENTATION AND DATE HPTV0070
00100 8* CD J. I. PREWITT HPTV0080
00100 9* CD DECEMBER 1970 HPTV0090
00100 10* CD HPTV0100
00100 11* CD PURPOSE HPTV0110
00100 12* CD COMPUTES THE VISCOSITY OF HYDROGEN HPTV0120
00100 13* CD HPTV0130
00100 14* CD USAGE HPTV0140
00100 15* CD V = HPTV (PRES,TEMP) HPTV0150
00100 16* CD HPTV0160

```

00100 17. CD DESCRIPTION OF PARAMETERS HPTV0170
00100 18. CV HPTV0180
00100 19. CD INPUT HPTV0190
00100 20. CV CALLING SEQUENCE HPTV0200
00100 21. CD PRES - PRESSURE - PSIA HPTV0210
00100 22. CD TEMP - TEMPERATURE - O R HPTV0220
00100 23. CD HPTV0230
00100 24. CD OUTPUT HPTV0240
00100 25. CV CALLING SEQUENCE HPTV0250
00100 26. CD HPTV - VISCOSITY - LBF HR/FT/FT HPTV0260
00100 27. CV HPTV0270
00100 28. CD REMARKS AND RESTRICTIONS HPTV0280
00100 29. CD THIS ROUTINE WAS OBTAINED FROM NASA/MSC. HPTV0290
00100 30. CD HPTV0300
00100 31. CD SUBPROGRAMS REQUIRED HPTV0310
00100 32. CD NONE HPTV0320
00100 33. CD HPTV0330
00100 34. CD METHOD HPTV0340
00100 35. CD CHECKS ARE MADE ON PRESSURE AND TEMPERATURE TO OBTAIN HPTV0350
00100 36. CD POINTERS TO A VISCOSITY TABLE FOR INTERPOLATION. HPTV0360
00100 37. CD THIS ROUTINE WAS OBTAINED FROM NASA/MSC AND IS PART OF HPTV0370
00100 38. CD NBS COMPUTER PROGRAMS FOR THERMODYNAMIC AND TRANSPORT HPTV0380
00100 39. CD PROPERTIES OF HYDROGEN FROM 1 TO 5000 PSIA AND FOR HPTV0390
00100 40. CD TEMPERATURES FROM THE TRIPLE POINT (ABOUT 24.16 O K ) HPTV0400
00100 41. CD TO 5000. O R . AUTHORS ARE W.J.HALL, R.D.MCCARTY AND HPTV0410
00100 42. CD H.M.RODER , NBS REPORT NU 9288 , AUGUST 18, 1967, HPTV0420
00100 43. CD PP 188 , NASA NO N67-35527 HPTV0430
00100 44. CD HPTV0440
00100 45. CD * * * * * HPTV0450
00101 46. FUNCTION HPTV (PRES,TEMP) HPTV0460
00103 47. DIMENSION PS(20),TS(20),JP(21),MX(21),LOC(21),BP(21),DP(21),BT(21) HPTV0470
00103 48. 1,DT(21),V(531),AA(20),AB(16),AC(6),AD(6),AE(40),AF(24),AG(16), HPTV0480
00103 49. 2AH(21),AI(21),AJ(28),AK(12),AL(58),AM(21),AN(20),AO(24),AP(36), HPTV0490
00103 50. 3AQ(20),AR(58),AS(2),AT(44),AU(30),AV(27) HPTV0500
00104 51. EQUIVALENCE(AA,V),(AB,V(21)),(AC,V(37)),(AD,V(43)),(AE,V(49)),(AF,HPTV0510
00104 52. 1V(89)),(AG,V(113)),(AH,V(129)),(AI,V(150)),(AJ,V(171)),(AK,V(199))HPTV0520
00104 53. 2,(AL,V(211)),(AM,V(269)),(AN,V(271)),(AO,V(291)),(AP,V(315)),(AQ,HPTV0530
00104 54. 3(351)),(AR,V(371)),(AS,V(429)),(AT,V(431)),(AU,V(475)),(AV,V(505))HPTV0540
00105 55. DATA PS/1.022,2.04,4.08,14.25,43.69,99.128,151.165,176. HPTV0550
00105 56. 1182,185,186.5,187.25,187.46875,187.506,187.6385/ HPTV0560
00107 57. DATA TS/24.845,27.07,29.81,33.07,36.18,39.96,44.12,48.33,51.97,54. HPTV0570
00107 58. 179.56,72.57,80.58,57.58,99.59,18.59,29.59,34.59,353.59,356.59,4/ HPTV0580
00111 59. DATA LOC/1,21,37,43,49,89,113,129,150,171,199,211,271,291,315,351, HPTV0590
00111 60. 1371,431,475,505,523/ HPTV0600
00113 61. DATA JP/4,4,3,3,5,3,2,3,3,4,3,6,4,6,4,5,5,11,6,3,3/ HPTV0610
00115 62. DATA MX/2,2,1,1,3,1,0,1,1,2,1,4,2,4,2,3,3,9,4,1,1/ HPTV0620
00117 63. DATA BP/140.96,0.1,1,500,1,1,10,500,1469.6,1469.6,1469.6, HPTV0630
00117 64. 16,0,0,0,587.84,0,293.92,190,190,190,190,190, HPTV0640
00121 65. DATA DP/440.88,1000,1,1000,1,20,1000,1763.52,1763.52,1175.68, HPTV0650
00121 66. 1,1763.52,293.92,73.48,293.92,293.92,146.96,73.48,10,20,50,50, HPTV0660
00123 67. DATA BT/180,500,2000,2880,2880,2880,30.6,41.4,63,126, HPTV0670
00123 68. 1,27,36,126,54,99,59,4,59,4,64,8,72,81, HPTV0680
00125 69. DATA DT/90,500,700,700,360,360,360,1.8,3.6,9,18,3.6,18, HPTV0690
00125 70. 118,9,9,3.6,1.8,1.8,1.8,9, HPTV0700
00127 71. DATA AA / 2.484E-11,2.625E-11,2.804E-11,3.034E-11, HPTV0710
00127 72. 1 3.418E-11,3.459E-11,3.528E-11,3.618E-11,4.146E-11,4.172E-11, HPTV0720
00127 73. 2 4.214E-11,4.268E-11,4.786E-11,4.805E-11,4.833E-11,4.871E-11, HPTV0730
00127 74. 3 5.367E-11,5.381E-11,5.403E-11,5.430E-11/ HPTV0740

```

00131 75° DATA AB / 5.135E-11, 5.174E-11, 5.240E-11, 5.306E-11,
 00131 76° 1 7.993E-11, 8.008E-11, 8.034E-11, 8.069E-11, 8.057E-10, 8.058E-10,
 00131 77° 2 1.059E-10, 1.061E-10, 1.266E-10, 1.267E-10, 1.267E-10, 1.269E-10/
 00133 78° DATA AC / 1.266E-10, 1.266E-10, 1.266E-10, 1.476E-10,
 00133 79° 1 1.513E-10, 1.521E-10/
 00135 80° DATA AD / 1.266E-10, 1.267E-10, 1.268E-10, 1.519E-10,
 00135 81° 1 1.529E-10, 1.535E-10/
 00137 82° DATA AE / 1.587E-10, 1.602E-10, 1.608E-10, 1.610E-10,
 00137 83° 1 1.612E-10, 1.738E-10, 1.761E-10, 1.768E-10, 1.772E-10, 1.774E-10,
 00137 84° 2 1.865E-10, 1.894E-10, 1.904E-10, 1.909E-10, 1.912E-10, 1.969E-10,
 00137 85° 3 2.006E-10, 2.018E-10, 2.024E-10, 2.027E-10, 2.055E-10, 2.098E-10,
 00137 86° 4 2.112E-10, 2.119E-10, 2.124E-10, 2.124E-10, 2.174E-10, 2.190E-10,
 00137 87° 5 2.199E-10, 2.204E-10, 2.179E-10, 2.236E-10, 2.255E-10, 2.264E-10,
 00137 88° 6 2.270E-10, 2.223E-10, 2.287E-10, 2.308E-10, 2.319E-10, 2.325E-10/
 00141 89° DATA AF / 1.603E-10, 1.615E-10, 1.616E-10, 1.762E-10,
 00141 90° 1 1.778E-10, 1.780E-10, 1.894E-10, 1.917E-10, 1.920E-10, 2.006E-10,
 00141 91° 2 2.034E-10, 2.038E-10, 2.100E-10, 2.132E-10, 2.137E-10, 2.174E-10,
 00141 92° 3 2.214E-10, 2.220E-10, 2.235E-10, 2.282E-10, 2.290E-10, 2.285E-10,
 00141 93° 4 2.339E-10, 2.349E-10/
 00143 94° DATA AG / 1.610E-10, 1.593E-10, 1.760E-10, 1.713E-10,
 00143 95° 1 1.894E-10, 1.836E-10, 2.015E-10, 1.961E-10, 2.123E-10, 2.088E-10,
 00143 96° 2 2.221E-10, 2.215E-10, 2.308E-10, 2.339E-10, 2.387E-10, 2.461E-10/
 00145 97° DATA AH / 1.838E-10, 2.745E-10, 0.000E-10, 1.645E-10,
 00145 98° 1 2.572E-10, 0.000E-10, 1.496E-10, 2.341E-10, 3.211E-10, 1.381E-10,
 00145 99° 2 2.145E-10, 2.940E-10, 1.266E-10, 1.958E-10, 2.659E-10, 1.182E-10,
 00145 100° 3 1.804E-10, 2.432E-10, 1.100E-10, 1.674E-10, 2.237E-10/
 00147 101° DATA AI / 1.100E-10, 1.674E-10, 2.237E-10, 9.723E-11,
 00147 102° 1 1.467E-10, 1.938E-10, 8.717E-11, 1.308E-10, 1.717E-10, 7.898E-11,
 00147 103° 2 1.184E-10, 1.547E-10, 7.217E-11, 1.084E-10, 1.413E-10, 6.587E-11,
 00147 104° 3 9.780E-10, 1.297E-10, 6.091E-11, 9.124E-11, 1.209E-10/
 00151 105° DATA AJ / 6.091E-11, 8.175E-11, 1.020E-10, 1.209E-10,
 00151 106° 1 5.159E-11, 7.068E-11, 8.807E-11, 1.043E-10, 4.432E-11, 6.179E-11,
 00151 107° 2 7.734E-11, 9.191E-11, 3.911E-11, 5.524E-11, 6.936E-11, 8.264E-11,
 00151 108° 3 3.553E-11, 5.021E-11, 6.317E-11, 7.540E-11, 3.280E-11, 4.627E-11,
 00151 109° 4 5.823E-11, 6.956E-11, 3.134E-11, 4.364E-11, 5.458E-11, 6.503E-11/
 00153 110° DATA AK / 3.050E-11, 4.650E-11, 6.177E-11, 2.946E-11,
 00153 111° 1 4.211E-11, 5.525E-11, 2.962E-11, 4.035E-11, 5.165E-11, 3.034E-11,
 00153 112° 2 3.954E-11, 4.874E-11/
 00155 113° DATA AL / 1.290E-10, 1.480E-10, 1.677E-10, 1.866E-10,
 00155 114° 1 2.058E-10, 2.250E-10, 1.033E-10, 1.183E-10, 1.335E-10, 1.493E-10,
 00155 115° 2 1.656E-10, 1.825E-10, 8.563E-11, 9.818E-11, 1.107E-10, 1.233E-10,
 00155 116° 3 1.363E-10, 1.496E-10, 7.246E-11, 8.358E-11, 9.433E-11, 1.050E-10,
 00155 117° 4 1.158E-10, 1.267E-10, 6.196E-11, 7.234E-11, 8.199E-11, 9.135E-11,
 00155 118° 5 1.006E-10, 1.100E-10, 5.305E-11, 6.324E-11, 7.223E-11, 8.073E-11,
 00155 119° 6 0.902E-11, 9.723E-11, 4.487E-11, 5.552E-11, 6.423E-11, 7.216E-11,
 00155 120° 7 7.974E-11, 8.717E-11, 3.647E-11, 4.869E-11, 5.747E-11, 6.505E-11,
 00155 121° 8 7.214E-11, 7.898E-11, 2.615E-11, 4.232E-11, 5.160E-11, 5.906E-11,
 00155 122° 9 6.576E-11, 7.217E-11, 0.656E-11, 3.651E-11, 4.645E-11, 5.353E-11/
 00157 123° DATA AM / 6.013E-11, 6.587E-11/
 00161 124° DATA AN / 0.630E-11, 0.749E-11, 0.580E-11, 0.000E-11,
 00161 125° 1 0.930E-11, 1.004E-11, 1.209E-11, 2.554E-11, 1.198E-11, 1.249E-11,
 00161 126° 2 1.318E-11, 1.434E-11, 1.442E-11, 1.483E-11, 1.530E-11, 1.587E-11,
 00161 127° 3 1.667E-11, 1.701E-11, 1.738E-11, 1.780E-11/
 00163 128° DATA AO / 1.877E-11, 2.006E-11, 2.192E-11, 2.457E-11,
 00163 129° 1 2.739E-11, 3.019E-11, 2.075E-11, 2.185E-11, 2.325E-11, 2.513E-11,
 00163 130° 2 2.729E-11, 2.946E-11, 2.263E-11, 2.360E-11, 2.473E-11, 2.617E-11,
 00163 131° 3 2.785E-11, 2.962E-11, 2.428E-11, 2.532E-11, 2.625E-11, 2.744E-11,
 00163 132° 4 2.880E-11, 3.029E-11/

HPTV0750
 HPTV0760
 HPTV0770
 HPTV0780
 HPTV0790
 HPTV0800
 HPTV0810
 HPTV0820
 HPTV0830
 HPTV0840
 HPTV0850
 HPTV0860
 HPTV0870
 HPTV0880
 HPTV0890
 HPTV0900
 HPTV0910
 HPTV0920
 HPTV0930
 HPTV0940
 HPTV0950
 HPTV0960
 HPTV0970
 HPTV0980
 HPTV0990
 HPTV1000
 HPTV1010
 HPTV1020
 HPTV1030
 HPTV1040
 HPTV1050
 HPTV1060
 HPTV1070
 HPTV1080
 HPTV1090
 HPTV1100
 HPTV1110
 HPTV1120
 HPTV1130
 HPTV1140
 HPTV1150
 HPTV1160
 HPTV1170
 HPTV1180
 HPTV1190
 HPTV1200
 HPTV1210
 HPTV1220
 HPTV1230
 HPTV1240
 HPTV1250
 HPTV1260
 HPTV1270
 HPTV1280
 HPTV1290
 HPTV1300
 HPTV1310
 HPTV1320

```

00165 133* DATA IP / 5.444E-11,6.191E-11,6.881E-11,7.543E-11,
00165 134* 1 4.154E-11,4.721E-11,5.559E-11,6.091E-11,3.164E-11,3.988E-11,
00165 135* 2 4.613E-11,5.159E-11,2.517E-11,3.308E-11,3.919E-11,4.432E-11,
00165 136* 3 2.234E-11,2.867E-11,3.427E-11,3.911E-11,2.131E-11,2.623E-11,
00165 137* 4 3.099E-11,3.553E-11,2.113E-11,2.509E-11,2.900E-11,3.280E-11,
00165 138* 5 2.141E-11,2.463E-11,2.792E-11,3.134E-11,2.192E-11,2.457E-11,
00165 139* 6 2.739E-11,3.019E-11/
00167 140* DATA AQ / 1.557E-11,1.635E-11,1.739E-11,1.901E-11,
00167 141* 1 2.131E-11,1.667E-11,1.738E-11,1.826E-11,1.948E-11,2.113E-11,
00167 142* 2 1.774E-11,1.839E-11,1.916E-11,2.014E-11,2.141E-11,1.877E-11,
00167 143* 3 1.941E-11,2.006E-11,2.099E-11,2.192E-11/
00171 144* DATA AR / 3.651E-11,3.900E-11,4.148E-11,4.397E-11,
00171 145* 1 4.645E-11,2.868E-11,3.350E-11,3.675E-11,3.938E-11,4.154E-11,
00171 146* 2 2.076E-11,2.766E-11,3.178E-11,3.483E-11,3.716E-11,1.740E-11,
00171 147* 3 2.262E-11,2.722E-11,3.068E-11,3.329E-11,1.649E-11,2.000E-11,
00171 148* 4 2.377E-11,2.712E-11,3.000E-11,1.614E-11,1.857E-11,2.156E-11,
00171 149* 5 2.448E-11,2.720E-11,1.612E-11,1.790E-11,2.025E-11,2.270E-11,
00171 150* 6 2.517E-11,1.625E-11,1.766E-11,1.950E-11,2.154E-11,2.370E-11,
00171 151* 7 1.649E-11,1.766E-11,1.913E-11,2.086E-11,2.268E-11,1.676E-11,
00171 152* 8 1.774E-11,1.896E-11,2.044E-11,2.202E-11,1.707E-11,1.790E-11,
00171 153* 9 1.892E-11,2.019E-11,2.157E-11,1.739E-11,1.820E-11,1.901E-11/
00173 154* DATA AS / 2.016E-11,2.317E-11/
00175 155* DATA AT / 2.484E-11,2.818E-11,2.970E-11,3.086E-11,
00175 156* 1 3.181E-11,3.261E-11,3.335E-11,3.401E-11,3.461E-11,3.520E-11,
00175 157* 2 3.573E-11,1.431E-11,1.560E-11,1.812E-11,2.297E-11,2.590E-11,
00175 158* 3 2.757E-11,2.885E-11,2.987E-11,3.076E-11,3.154E-11,3.225E-11,
00175 159* 4 1.368E-11,1.429E-11,1.511E-11,1.626E-11,1.791E-11,2.015E-11,
00175 160* 5 2.259E-11,2.458E-11,2.611E-11,2.728E-11,2.831E-11,1.350E-11,
00175 161* 6 1.394E-11,1.438E-11,1.508E-11,1.578E-11,1.689E-11,1.800E-11,
00175 162* 7 1.949E-11,2.099E-11,2.246E-11,2.394E-11/
00177 163* DATA AU / 1.350E-11,1.438E-11,1.578E-11,1.800E-11,
00177 164* 1 2.099E-11,2.394E-11,1.347E-11,1.412E-11,1.503E-11,1.634E-11,
00177 165* 2 1.815E-11,2.032E-11,1.353E-11,1.404E-11,1.471E-11,1.562E-11,
00177 166* 3 1.683E-11,1.833E-11,1.363E-11,1.405E-11,1.459E-11,1.526E-11,
00177 167* 4 1.615E-11,1.729E-11,1.377E-11,1.414E-11,1.458E-11,1.514E-11,
00177 168* 5 1.582E-11,1.664E-11/
00201 169* DATA AV / 1.377E-11,1.484E-11,1.664E-11,1.393E-11,
00201 170* 1 1.486E-11,1.635E-11,1.409E-11,1.489E-11,1.610E-11,1.427E-11,
00201 171* 2 1.499E-11,1.604E-11,1.445E-11,1.509E-11,1.600E-11,1.464E-11,
00201 172* 3 1.523E-11,1.604E-11,1.464E-11,1.523E-11,1.604E-11,1.563E-11,
00201 173* 4 1.606E-11,1.659E-11,1.662E-11,1.697E-11,1.736E-11/
00203 174* P=PRES
00204 175* IF (P.LT.1.0) P=1.0
00206 176* T=TEMP
00207 177* IF (T.LT.180.0) GO TO 70
00211 178* IF (T.GE.540.0) GO TO 10
00213 179* N=1
00214 180* GO TO 260
00215 181* 10 IF (T.GE.2700.0) GO TO 40
00217 182* IF (T.GE.2000.0) GO TO 20
00221 183* N=2
00222 184* GO TO 260
00223 185* 20 IF (P.GT.6.0) GO TO 30
00225 186* N=3
00226 187* GO TO 260
00227 188* 30 N=4
00230 189* GO TO 260
00231 190* 40 IF (T.GE.5400.0) T=5399.99999

```

```

HPTV1330
HPTV1340
HPTV1350
HPTV1360
HPTV1370
HPTV1380
HPTV1390
HPTV1400
HPTV1410
HPTV1420
HPTV1430
HPTV1440
HPTV1450
HPTV1460
HPTV1470
HPTV1480
HPTV1490
HPTV1500
HPTV1510
HPTV1520
HPTV1530
HPTV1540
HPTV1550
HPTV1560
HPTV1570
HPTV1580
HPTV1590
HPTV1600
HPTV1610
HPTV1620
HPTV1630
HPTV1640
HPTV1650
HPTV1660
HPTV1670
HPTV1680
HPTV1690
HPTV1700
HPTV1710
HPTV1720
HPTV1730
HPTV1740
HPTV1750
HPTV1760
HPTV1770
HPTV1780
HPTV1790
HPTV1800
HPTV1810
HPTV1820
HPTV1830
HPTV1840
HPTV1850
HPTV1860
HPTV1870
HPTV1880
HPTV1890
HPTV1900

```

G FOR, HPTV, HPTV

DATE 310871 PAGE 178

00233	191°	IF (P.GE.5.0) GO TO 50	HPTV1910
00235	192°	N=5	HPTV1920
00236	193°	GO TO 260	HPTV1930
00237	194°	50 IF (P.GE.40.0) GO TO 60	HPTV1940
00241	195°	N=6	HPTV1950
00242	196°	GO TO 260	HPTV1960
00243	197°	60 N=7	HPTV1970
00244	198°	GO TO 260	HPTV1980
00245	199°	70 IF (P.LT.1469.6) GO TO 120	HPTV1990
00247	200°	IF (T.GE.63.0) GO TO 100	HPTV2000
00251	201°	IF (T.GE.41.4) GO TO 90	HPTV2010
00253	202°	N=8	HPTV2020
00254	203°	80 TZ=24.84*0.00317*P	HPTV2030
00255	204°	IF (T.LT.TZ) T=TZ	HPTV2040
00257	205°	GO TO 260	HPTV2050
00260	206°	90 N=9	HPTV2060
00261	207°	GO TO 260	HPTV2070
00262	208°	100 IF (T.GE.117.0) GO TO 110	HPTV2080
00264	209°	N=10	HPTV2090
00265	210°	GO TO 260	HPTV2100
00266	211°	110 N=11	HPTV2110
00267	212°	GO TO 260	HPTV2120
00270	213°	120 IF (T.GE.59.4) GO TO 170	HPTV2130
00272	214°	N=12	HPTV2140
00273	215°	IF (P.GE.187.6385) GO TO 80	HPTV2150
00275	216°	DO 130 I=2,20	HPTV2160
00300	217°	IF (P=PS(I)) 150,140,130	HPTV2170
00303	218°	130 CONTINUE	HPTV2180
00305	219°	140 TL=TS(I)	HPTV2190
00306	220°	GO TO 160	HPTV2200
00307	221°	150 TL=TS(I-1)*(TS(I)-TS(I-1))/(P-PS(I-1))/(PS(I)-PS(I-1))	HPTV2210
00310	222°	160 IF (T.LE.TL) GO TO 80	HPTV2220
00312	223°	N=13	HPTV2230
00313	224°	GO TO 260	HPTV2240
00314	225°	170 IF (T.LT.126.0) GO TO 180	HPTV2250
00316	226°	N=14	HPTV2260
00317	227°	GO TO 260	HPTV2270
00320	228°	180 IF (P.LT.587.84) GO TO 190	HPTV2280
00322	229°	N=15	HPTV2290
00323	230°	GO TO 260	HPTV2300
00324	231°	190 IF (T.LT.99.0) GO TO 200	HPTV2310
00326	232°	N=16	HPTV2320
00327	233°	GO TO 260	HPTV2330
00330	234°	200 IF (P.GE.190.0) GO TO 210	HPTV2340
00332	235°	N=13	HPTV2350
00333	236°	GO TO 260	HPTV2360
00334	237°	210 IF (P.LT.293.92) GO TO 220	HPTV2370
00336	238°	N=17	HPTV2380
00337	239°	GO TO 260	HPTV2390
00340	240°	220 IF (T.GE.72.0) GO TO 240	HPTV2400
00342	241°	IF (T.GE.64.8) GO TO 230	HPTV2410
00344	242°	N=18	HPTV2420
00345	243°	GO TO 260	HPTV2430
00346	244°	230 N=19	HPTV2440
00347	245°	GO TO 260	HPTV2450
00350	246°	240 IF (T.GE.81.0) GO TO 250	HPTV2460
00352	247°	N=20	HPTV2470
00353	248°	GO TO 260	HPTV2480


```

00354 249* 250 N=21
00355 250* 260 FP=(P-8P(N))/DT(N)
00356 251* IP=FP
00357 252* IF(1P.GT.MX(N)) IP=MX(N)
00361 253* FI=IP
00362 254* F=FP-FI
00363 255* FP=1.0-F
00364 256* FT=(T-BT(N))/DT(N)
00365 257* IT=FT
00366 258* FI=IT
00367 259* FF=FT-FI
00370 260* FT=1.0-FF
00371 261* I=IT*JP(N)+IP+LOC(N)
00372 262* J=I+JP(N)
00373 263* PTVISC=FF*FT*V(I)+F*FT*V(I+1)+FP*FF*V(J)+F*FF*V(J+1)
00374 264* HPTV = PTVISC
00375 265* RETURN
00376 266* END

```

```

HPTV250
HPTV2500
HPTV2510
HPTV2520
HPTV2530
HPTV2540
HPTV2550
HPTV2560
HPTV2570
HPTV2580
HPTV2590
HPTV2600
HPTV2610
HPTV2620
HPTV2630
HPTV2640
HPTV2650
HPTV2660

```

END OF UNIVAC 1108 FORTRAN V COMPILATION. 0 *DIAGNOSTIC* MESSAGE(S)

HPTV	CODE	SYMBOLIC	RELOCATABLE	01 MAR 71	18:48:13	0	01566044	14	266	(DELETED)
HPTV				30 APR 71	11:19:34	1	01462674	24	1	(DELETED)
						0	01462724	14	100	

Q HDG Q FOR, HYDRO, HYDRO

3.2.29 HYDRO

@ FOR,* HYDRO, HYDRO
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:31

31 AUG 71

9:27:30.906

SUBROUTINE HYDRO ENTRY POINT 000102

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000137
 0000 *DATA 000323
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 INTER2
 0004 EXP
 0005 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000 R 000020 ADEN	0000 R 000000 AP	0000 R 000003 ATI	0000 R 000104 BC	0000 R 000101 BP
0000 R 000070 BT	0000 R 000152 CHU	0000 R 000137 CT	0000 R 000224 DCP	0000 R 000302 DEN
0000 R 000221 DP	0000 R 000202 DT	0000 R 000147 EP	0000 I 000067 IS	0000 R 000301 TI

00101 1* SUBROUTINE HYDRO (P,T,SV,MU,K,CP,PR)
 00101 2* CC
 00101 3* CC THIS SUBROUTINE COMPUTES SUPERCRITICAL HYDROGEN PROPERTIES IN
 00101 4* CC THE RANGE 1000 PSIA TO 2000 PSIA AND 40 DEG R TO 800 DEG R.
 00101 5* CC INPUT P = PRESSURE (PSIA)
 00101 6* CC T = TEMPERATURE (DEG R)
 00101 7* CC OUTPUT SV= SPECIFIC VOLUME (CUIN/POUND)
 00101 8* CC MU= VISCOSITY (POUNDS/IN-SEC)
 00101 9* CC K = CONDUCTIVITY (BTU/IN-SEC-DEG R)
 00101 10* CC CP= SPECIFIC HEAT, CONST PRESS (BTU/POUND-DEG R)
 00101 11* CC PR= PRANDTL NUMBER (CP*MU/K), COMPUTED
 00101 12* CC
 00103 13* REAL MU,K
 00103 14* CC
 00103 15* CC DENSITY DATA VS. INVERSE TEMP AND PRESS
 00103 16* CC SPECIFIC VOLUME COMPUTED
 00104 17* DIMENSION AP(3),ATI(13),ADEN(13,3)
 00105 18* DATA AP/1000.0, 1500.0, 2000.0/
 00107 19* DATA ATI/1.25, 1.667, 2.5, 3.333, 5.0, 6.667, 10.0, 11.1,
 00107 20* 12.50, 14.28, 16.67, 20.0, 25.0/
 00111 21* DATA ADEN/0.2280, 0.3018, 0.4479, 0.5758, 0.7084, 1.270, 2.290,
 00111 22* 2.7080, 3.1920, 3.6670, 4.0860, 4.4510, 4.750,
 00111 23* 0.3368, 0.4440, 0.6553, 0.8679, 1.3160, 1.823, 2.299,
 00111 24* 3.3370, 3.6960, 4.0450, 4.3650, 4.6570, 4.911,
 00111 25* 0.4421, 0.5804, 0.8519, 1.1220, 1.6010, 2.201, 3.424,
 00111 26* 3.7170, 4.0130, 4.3020, 4.5720, 4.8220, 5.047/

```

00111 27* CC
00111 28* CC
00113 29* CONDUCTIVITY DATA (*1.0E+6)
00114 30* DIMENSION BT( 9),BP( 3),BC(9,3)
00114 31* DATA BT/ 40.0, 60.0, 100.0, 130.0, 160.0, 200.0, 340.0, 600.0,
00114 32* 1 1000.0/
00116 33* DATA BP/ 1000.0, 1500.0, 2000.0/
00120 34* DATA BC/1.7267, 1.6296, 1.4468, 1.5602, 1.6990, 1.6991, 1.9606,
00120 35* 1 2.9236, 4.2847,
00120 36* 2 1.8889, 1.6075, 1.6782, 1.6921, 1.8056, 1.8079, 2.1296,
00120 37* 3 3.0069, 4.3171,
00120 38* 4 2.0278, 1.7662, 1.8218, 1.8542, 1.8727, 1.8889, 2.2037,
00120 39* 5 3.0926, 4.3495/
00120 39* CC
00120 40* CC
00122 41* VISCOSITY DATA (ALOG(MU*1.0E+7))
00123 42* DIMENSION CT(8),EP(3),CMU(8,3)
00125 43* DATA CT/ 40.0, 60.0, 100.0, 130.0, 160.0, 340.0, 600.0, 1000.0/
00127 44* DATA EP/ 1000.0, 1500.0, 2000.0/
00127 45* DATA CMU/ 2.520, 1.793, 0.8473, 0.8072, 0.8544, 1.337, 1.693,
00127 46* 1 2.015,
00127 47* 2 2.897, 2.008, 1.189, 0.9491, 0.9746, 1.359, 1.693, 2.015,
00127 48* 3 3.182, 2.195, 1.435, 1.1120, 1.0590, 1.382, 1.693, 2.015/
00127 48* CC
00127 49* CC
00131 50* SPECIFIC HEAT CAPACITY DATA (CONST PRES)
00132 51* DIMENSION DT(15),DP(3),DCP(15,3)
00132 52* DATA DT/ 45.0, 55.0, 65.0, 75.0, 85.0, 95.0, 125.0, 175.0, 225.0,
00134 53* 1 275.0, 350.0, 450.0, 550.0, 650.0, 750.0/
00136 54* DATA DP/ 1000.0, 1500.0, 2000.0/
00136 55* DATA DCP/2.336, 2.842, 3.583, 3.758, 4.080, 4.212, 3.812, 3.692,
00136 56* 1 3.862, 4.010, 3.989, 3.728, 3.587, 3.520, 3.490,
00136 57* 2 2.188, 2.614, 3.157, 3.135, 3.335, 3.607, 3.782, 3.826,
00136 58* 3 3.954, 4.074, 4.037, 3.746, 3.614, 3.520, 3.500,
00136 59* 4 2.088, 2.484, 2.935, 2.849, 2.992, 3.247, 3.636, 3.884,
00136 60* 5 4.016, 4.120, 4.058, 3.759, 3.725, 3.530, 3.510/
00136 60* CC
00136 61* CC
00136 62* CC
00140 63* CALL INTER2 (T,DT,P,DP,CP,DCP,15,3)
00140 64* CC
00140 65* CC
00141 66* COMPUTE VISCOSITY
00142 67* CALL INTER2 (T,CT,P,EP,MU,CMU,8,3)
00142 68* MU= EXP(MU)*1.0E-7
00142 69* CC
00143 70* CC
00143 71* COMPUTE CONDUCTIVITY
00144 72* CALL INTER2 (T,BT,P,BP,K,BC,9,3)
00144 73* K=K*1.0E-6
00144 74* CC
00145 75* CC
00145 76* COMPUTE PRANDTL NUMBER
00146 77* PR= CP*MU/K
00147 78* CC
00147 79* CC
00147 80* COMPUTE SPECIFIC VOLUME FROM DENSITY LOOKUP
00150 81* TI=1000.0/T
00151 82* CALL INTER2 (TI,AT1,P,AP,DEN,ADEN,13,3)
00151 83* SV=1.0/DEN*1728.0
00152 84* RETURN
00152 85* END

```

		FOR,*	HYDRO, HYDRO
HYDRO	CODE	RELOCATABLE	
HnG		FOR,*	H2OH2, H2OH2

DATE	310871	PAGE	182		
30 APR 71	11:19:35	1	01467672	24	1 (DELETED)
		0	01467722	14	29

FOR, H2OH2, H2OH2
 UNIVAC 1108 FORTRAN V LEVEL 2204 0018 P5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:32

SUBROUTINE H2OH2 ENTRY POINT 000077

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000141
 0000 *DATA 000103
 0002 *BLANK 000000
 0003 CCPCX 000007

EXTERNAL REFERENCES (BLOCK, NAME)

0004 INTERP
 0005 INTER2
 0006 NEHR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000 R 000006 AP 0000 R 000000 AT 0000 R 000012 BCP 0000 R 000034 CX 0003 R 000000 CPCX
 0000 R 000056 DMU 0003 I 000006 ICX 0000 I 000011 IS 0000 I 000064 KKK

124

```

00101 1*      SUBROUTINE H2OH2 (P,T,SV,MU,K,CP,PR)
00101 2*      CC
00101 3*      CC          THIS SUBROUTINE COMPUTES FLOW PROPERTIES OF THE
00101 4*      CC          COMBUSTION PRODUCTS OF AN OXYGEN-HYDROGEN GAS GENERATOR OPERATING
00101 5*      CC          AT A MIXTURE RATIO OF 1.0, THUS THE GAS OUTPUT CONSISTS OF 86.7
00101 6*      CC          PERCENT HYDROGEN AND 12.6 PERCENT STEAM ON A MOLE FRACTION BASIS.
00101 7*      CC          INPUTS   P = PRESSURE (PSIA)
00101 8*      CC          T = TEMPERATURE (DEG R)
00101 9*      CC          OUTPUTS  SV= SPECIFIC VOLUME (CUIN/POUND)
00101 10*     CC          MU= VISCOSITY (POUNDS/IN-SEC)
00101 11*     CC          K = CONDUCTIVITY (BTU/IN-SEC-DEGR)
00101 12*     CC          CP= SPECIFIC HEAT, CONST PRESS (BTU/POUND-DEG R)
00101 13*     CC          PR= PRANDTL NUMBER (CP*MU/K)
00101 14*     CC
00103 15*     REAL MU,K
00104 16*     COMMON /CCPCX/ CPCX(6), ICX
00104 17*     CC
00105 18*     DIMENSION AT(6), AP(3)
00106 19*     DATA AP/146.96,440.88,1496.60/
00110 20*     DATA AT/600.0,1100.0,1600.0,2100.0,2600.0,3100.0/
00110 21*     CC
00110 22*     CC          SPECIFIC HEAT DATA (AT SAME POINTS AS PRANDTL NO. DATA)
00112 23*     DIMENSION BCP(6,3)
00113 24*     DATA BCP/1.7906,1.9051,2.0569,2.2568,2.9375,5.0492,
00113 25*     1      1.7906,1.9051,2.0560,2.2234,2.6584,3.9052,
00113 26*     2      1.7906,1.9051,2.0554,2.2028,2.4860,3.2028/

```

```

00113 27* CC
00113 28* CC      CONDUCTIVITY DATA (AT SAME DATA POINTS AS PRANDTL NO.)
00113 29* CC      CONDUCTIVITY DATA *10**(*6)
00115 30*      DIMENSION CK(6,3)
00116 31*      DATA CK/3.421,5.527,7.734,10.511,18.240,41.833,
00116 32*      1      3.421,5.527,7.728,10.248,15.703,30.50,
00116 33*      2      3.421,5.527,7.723,10.091,14.123,23.35/
00116 34* CC
00116 35* CC      VISCOSITY DATA WAS NOT FOUND TO BE A FUNCTION OF PRESSURE
00116 36* CC      VISCOSITY DATA*1.0E+6
00120 37*      DIMENSION DMU(6)
00121 38*      DATA DMU/1.03, 1.59, 2.16, 2.48, 2.91, 3.32/
00121 39* CC
00121 40* CC      SPECIFIC VOLUME DATA
00121 41* CC      SINCE THIS DATA IS NOT AVAILABLE IT WILL BE APPROXIMATED
00121 42* CC      BY THE IDEAL GAS LAW ASSUMING 1.0 MIXTURE RATIO
00123 43*      SV=4616.50*T/P
00124 44*      T=T/1.8
00124 45* CC
00124 46* CC      VISCOSITY COMPUTATION
00125 47*      CALL INTERP (6,AT,DMU,T,MU,KKK)
00126 48*      MU=MU*1.0E-6
00126 49* CC
00126 50* CC      SPECIFIC HEAT COMPUTATION
00127 51*      CALL INTER2 (T,AT,P,AP,CP,BCP,6,3)
00127 52* C
00127 53* C      IF GAS GENERATOR CONNECTED, USE PREVIOUSLY COMPUTED CP IN CHAM ROUTINE
00127 54* C      ICX = COMBUSTOR NO. HOOKED TO HEAT EXCHANGER
00130 55*      IF ( ICX.NE.0) CP = CPCX(ICX)
00130 56* CC
00130 57* CC      CONDUCTIVITY COMPUTATION
00132 58*      CALL INTER2 (T,AT,P,AP,K,CK,6,3)
00133 59*      K=K*1.0E-6
00134 60*      T=1.8*T
00134 61* CC      PRANDTL NUMBER
00135 62*      PR = CP * MU / K
00136 63*      RETURN
00137 64*      END

```

125

```

      END OF UNIVAC 1108 FORTRAN V COMPILATION.      0 *DIAGNOSTIC* MESSAGE(S)
H2OH2      SYMBOLIC      17 JUN 71 13:50:55      0 01672512      14      64 (DELETED)
H2OH2      CODE      RELOCATABLE      17 JUN 71 13:50:55      1 01674312      24      1 (DELETED)
                                0 01674342      14      16
@ HDG      @      FOR,*      INITIAL,INITAL

```

FOR: * INITIAL,INITAL
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:33

31 AUG 71

9:27:33.517

SUBROUTINE INITIAL ENTRY POINT 0000S6

STORAGE USED (BLOCK, NAME, LENGTH)

```
0001 *CODE 000062
0000 *DATA 000030
0002 *BLANK 000000
0003 ARRAY 000047
```

EXTERNAL REFERENCES (BLOCK, NAME)

```
0004 NWDUS
0005 NIOZS
0006 NERR3S
```

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

```
0001 000002 1076 . 0001 000017 20L 0000 000001 900F 0003 R 000000 A 0003 R 000006 CP1
0003 R 000012 GAM 0000 I 000000 I 0003 R 000041 M1 0003 R 000001 P 0003 R 000004 RHOL
0003 R 000010 R1 0003 R 000002 T 0003 R 000044 U 0003 R 000005 VTANK 0003 R 000043 W
0003 R 000003 WOL
```

```
00101 1* SUBROUTINE INITIAL
00101 2* C
00101 3* C INITIALIZE DATA AT TIME = 0
00101 4* C
00103 5* COMMON /ARRAY/ A(39)
00104 6* EQUIVALENCE (A(7),CP1),(A(9),R1),(A(11),GAM)
00104 7* 1, (A(34),M1),(A(2),P),(A(3),T),(A(6),VTANK),(A(4),WOL),(A(5),RHOL)
00104 8* 2, (A(36),W),(A(37),U)
00105 9* REAL M1
00105 10* C
00106 11* DO 10 I=22,37
00111 12* 10 A(I) = 0.
00113 13* IF (RHOL.GT.0.) GO TO 20
00115 14* RHOL = 65.
00116 15* WRITE (6,900)
00120 16* 900 FORMAT (1H ,44HTANK-ROUTINE RHOL NOT INITIALIZED-SET TO 65. )
00121 17* 20 CONTINUE
00122 18* GAM = CP1 / (CP1-R1)
00123 19* M1 = 144. * P*(VTANK - WOL/RHOL) / R1 / T / 778.156
00124 20* W = WOL
00125 21* U = M1 * (CP1-R1) * T
00126 22* RETURN
00127 23* END
```

@ FOR,* INITIAL,INITAL

DATE 310871 PAGE 186

END OF UNIVAC 1108 FORTRAN V COMPILATION.

@ *DIAGNOSTIC* MESSAGE(5)

INITAL SYMBOLIC
INITAL CODE RELOCATABLE

23 JUN 71	21:25:47	0	01705630	14	23	(DELETED)
23 JUN 71	21:25:47	1	01706332	24	1	(DELETED)
		0	01706362	14	8	

@ HDG @ FOR,* INTEG,INTEG

FOR, • INTEG,INTEG
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F8018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:34

SUBROUTINE INTEG ENTRY POINT 000053

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000066
0000	*DATA	000016
0002	*BLANK	000000
0003	ARRAY	000047

EXTERNAL REFERENCES (BLOCK, NAME)

0004 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000010	10L	0001	000041	100L	0001	000017	117G	0001	000030	30L	0003	R	000000	A
0000	I	000000	J	0003	R	000045	T0	0003	R	000046	T1	0003	R	000025	X
												0003	R	000035	Y

128

```

00101 1* SUBROUTINE INTEG (K, ZDOT, TIME)
00103 2* DIMENSION X( 4,2), Y( 4,2)
00104 3* COMMON /ARRAY/ A(39)
00105 4* EQUIVALENCE (A(22),X), (A(30),Y), (A(38),T0), (A(39),T1)
00105 5* C
00105 6* C X CONTAINS THE LAST 2 VALUES OF ZDOT FOR EACH VARIABLE BEING INTEGRATED
00105 7* C Y CONTAINS THE INTEGRALS OF THE VARIABLES AT THE LAST 2 TIMES. THE VALUES
00105 8* C ARE UPDATED AFTER THE CURRENT INTEGRATION,
00105 9* C K DESIGNATES THE VARIABLE BEING INTEGRATED
00105 10* C
00106 *DIAGNOSTIC* THE TEST FOR EQUALITY BETWEEN NON-INTEGERS MAY NOT BE MEANINGFUL,
00106 11* IF (TIME.NE.0.) GO TO 10
00110 12* X(K,2) = ZDOT
00111 13* T1 = 0.
00112 14* GO TO 100
00113 15* 10 CONTINUE
00114 16* IF (TIME.LE.T1) GO TO 30
00114 17* C UPDATE TIME AND DATA ARRAYS
00116 18* DO 20 J=1,4
00121 19* X(J,1) = X(J,2)
00122 20* Y (J,1) = Y (J,2)
00124 21* T0 = T1
00125 22* T1 = TIME
00126 23* 30 CONTINUE
00126 24* C UPDATING COMPLETE. ENTER NEW DATA.
00127 25* X(K,2) = ZDOT
00130 26* Y (K,2) = Y (K,1) + (T1-T0) * (X(K,1)+X(K,2)) / 2.
00131 27* 100 CONTINUE

```

FOR,• INTEG,INTEG

DATE 310871 PAGE 188

00132 28• RETURN
00133 29• END

END OF UNIVAC 1108 FORTRAN V COMPILATION.
INTEG SYMBOLIC
INTEG CODE RELOCATABLE

1 •DIAGNOSTIC• MESSAGE(S)

30 APR 71	11:19:39	0	01470550	14	29	(DELETED)
30 APR 71	11:19:39	1	01471376	24	1	(DELETED)
		0	01471426	14	7	

MDG FOR,• INTERP,INTERP

FOR, INTERP INTER
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:35

SUBROUTINE INTERP ENTRY POINT 000223

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000306
 0000 *DATA 000024
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000130	110L	0001	000154	130L	0001	000137	142G	0001	000167	150L	0001	000015	20L
0001	000023	40L	0001	000044	60L	0001	000071	70L	0001	000100	80L	0001	000111	90L
0000	R	000001	ERROR	0000	I	000000	J							

130.

```

00101 1* SUBROUTINE INTERP (IMAX,XI,YI,X,Y,K)
00103 2*
00103 3* DIMENSION XI(1),YI(1)
00104 4* IF (K) 10,10,20
00107 5* 10 K=2
00110 6* 20 IF (K-IMAX) 40,40,30
00113 7* 30 K=IMAX
00114 8* 40 CONTINUE
00115 9* J=K-1
00116 10* IF (X-XI(K)) 50,70,90
00121 11* 50 IF (X-XI(J)) 130,80,60
00124 12* 60 Y=YI(J)+((YI(K)-YI(J))*(X-XI(J))/(XI(K)-XI(J)))
00125 13* RETURN
00126 14* 70 Y=YI(K)
00127 15* RETURN
00130 16* 80 Y=YI(J)
00131 17* X=J
00132 18* RETURN
00133 19* 90 IF (X-XI(IMAX)) 110,100,100
00136 20* 100 Y=YI(IMAX)
00137 21* K=IMAX
00140 22* RETURN
00141 23* 110 DO 120 K=K,IMAX
00144 24* ERROR = X-XI(K)
00145 25* J=K-1
00146 26* IF (ERROR) 60,70,120
00151 27* 120 CONTINUE
00153 28* 130 IF (X-XI(1)) 140,140,150

```

```

      @      FOR,*  INTERP,INTERP
00156  29*  140 Y=YI(1)
00157  30*      K=2
00160  31*      RETURN
00161  32*  150 K=K-1
00162  33*      J=K-1
00163  34*      IF (X-XI(J)) 150,70,60
00166  35*      END

```

DATE 310871 PAGE 190

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

INTERP SYMBOLIC
INTERP CODE RELOCATABLE

30 APR 71	11:19:40	0	01471570	14	35	(DELETED)
30 APR 71	11:19:40	1	01472542	24	1	(DELETED)
		0	01472572	14	20	

@ HDG @ FOR,* INTER2,INTER2

FOR, * INTER2, INTER2
 UNIVAC 1108 FORTRAN V LEVEL 2206 0014 15018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:37

SUBROUTINE INTER2 ENTRY POINT 000365

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000434
 0000 *DATA 000070
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000035	107G	0001	000064	124G	0001	000053	20L	0001	000061	30L	0001	000102	50L
0001	000110	60L	0001	000227	70L	0001	000275	80L	0001	000330	90L	0001	000340	999L
0000	I	000002	1	0000	I	000003	J	0000	I	000000	KX	0000	I	000001
0000	R	000005	X2	0000	R	000006	Y1	0000	R	000007	Y2	0000	R	000004

132

```

00101 1* SUBROUTINE INTER2 (X,XTAB,Y,YTAB,Z,ZTAB,N,M)
00103 2* DIMENSION XTAB(N),YTAB(M),ZTAB(N,M)
00103 3* CC
00103 4* CC THIS SUBROUTINE INTERPOLATES A FUNCTION Z OF TWO VARIABLES
00103 5* CC X AND Y, WHERE
00103 6* CC ZTAB(N,M) = TABLE OF Z(XTAB(N),YTAB(M)), DEPENDANT VAR.
00103 7* CC XTAB(N) = TABLE OF INDEPENDENT X VALUES
00103 8* CC YTAB(M) = TABLE OF INDEPENDENT Y VALUES
00103 9* CC X AND Y = INDEPENDENT VARIABLE INPUTS
00103 10* CC Z = DEPENDENT VARIABLE OUTPUT
00103 11* CC N AND M = RANGE OF TABLES (SHOULD BE VARIABLE IN CALL)
00103 12* CC
00104 13* KX=0
00105 14* KY=0
00105 15* CC FIND POSITION OF X IN XTAB(N)
00106 16* DO 10 I=1,N
00111 17* 10 IF(X.LT.XTAB(I)) GO TO 20
00111 18* CC X EXCEEDS TABLE
00114 19* KX=1
00115 20* I=N
00116 21* GO TO 30
00117 22* 20 CONTINUE
00117 23* CC IS X LESS THAN THE TABLE
00120 24* IF(I.EQ.1) KX=1
00122 25* 30 CONTINUE
00122 26* CC FIND POSITION OF Y IN YTAB(M)
00123 27* DO 40 J=1,M

```

```

00126 28. 40 IF(Y.LT.YTAB(J)) GO TO 50
00126 29. CC Y EXCEEDS TABLE
00131 30. KY=1
00132 31. J=M
00133 32. GO TO 60
00134 33. 50 CONTINUE
00134 34. CC IS Y LESS THAN THE TABLE
00135 35. IF(J.EQ.1) KY=1
00137 36. 60 CONTINUE
00137 37. CC BOTH INPUT VARIABLE POSITIONS HAVE NOW BEEN FOUND
00137 38. CC CHECK TO SEE IF ONE OR TWO DIMENSION INTERPOLATION
00137 39. CC SHOULD BE USED.
00140 40. IF(KX.EQ.1) GO TO 70
00142 41. IF(KY.EQ.1) GO TO 80
00142 42. CC TWO DIMENSION INTERPOLATION NEEDED
00144 43. X1=(X-XTAB(I-1))/(XTAB(I)-XTAB(I-1))
00145 44. X2=1.0-X1
00146 45. Y1=(Y-YTAB(J-1))/(YTAB(J)-YTAB(J-1))
00147 46. Y2=1.0-Y1
00150 47. Z= X1*Y1*ZTAB(I,J)
00150 48. 1 +X1*Y2*ZTAB(I,J-1)
00150 49. 2 +X2*Y1*ZTAB(I-1,J)
00150 50. 3 +X2*Y2*ZTAB(I-1,J-1)
00151 51. GO TO 999
00152 52. 70 CONTINUE
00152 53. CC X OUT OF BOUNDS, IS Y OUT OF BOUNDS
00153 54. IF(KY.EQ.1) GO TO 90
00153 55. CC Y IS IN BOUNDS, USE ONE DIMENSION INTERPOLATION
00155 56. Y1=(Y-YTAB(J-1))/(YTAB(J)-YTAB(J-1))
00156 57. Y2=1.0-Y1
00157 58. Z= Y1*ZTAB(I,J)+Y2*ZTAB(I,J-1)
00160 59. GO TO 999
00161 60. 80 CONTINUE
00161 61. CC X IS IN BOUNDS, Y IS NOT, INTERPOLATE X
00162 62. X1=(X-XTAB(I-1))/(XTAB(I)-XTAB(I-1))
00163 63. X2=1.0-X1
00164 64. Z= X1*ZTAB(I,J)+ X2*ZTAB(I-1,J)
00165 65. GO TO 999
00166 66. 90 CONTINUE
00166 67. CC BOTH X AND Y OUT OF RANGE, USE CORNER VALUE OF Z
00167 68. Z=ZTAB(I,J)
00170 69. 999 RETURN
00171 70. END

```

133

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

INTER2 SYMBOLIC
INTER2 CODE RELOCATABLE

30 APR 71 11:19:42
30 APR 71 11:19:42

0	01473222	14	70	(DELETED)
1	01475146	24	1	(DELETED)
0	01475176	14	30	

FOR, ISOTH,ISOTH

FOR, ISOIH, ISOIH
UNIVAC 1108 FORTRAN V LEVEL 220 118 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:38

31 AUG 71

9:27:38.698

SUBROUTINE ISOIH ENTRY POINT 000403

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000415
0000	*DATA	000067
0002	*BLANK	000000
0003	INDATA	011610
0004	CONS	000003
0005	COM	006525

EXTERNAL REFERENCES (BLOCK, NAME)

0006	OPTCP
0007	OPTCV
0010	OPTV
0011	HPTCP
0012	HPTCV
0013	HPTV
0014	FCOMP2
0015	NEHR2S
0016	SGRT
0017	NEXP6S
0020	NADUS
0021	NIOIS
0022	NIO2S
0023	NEHR3S

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000021	IL	0000	000015	IOF	0001	000043	2L	0001	000366	2GL	0001	000064	5L	
0005	R	000000	AREA	0005	R	000074	AREA1	0005	R	000170	AREAK	0005	R	000132	AREAO
0005	R	006423	CGGTC	0005	R	006436	CGTANK	0005	R	006431	CLTANK	0005	R	005014	CONCT
0005	R	006443	CPJU	0005	R	005006	CSTAR	0005	R	006355	CVEL	0000	R	000011	CYGAS
0005	R	000226	DIALI	0005	R	006277	DMVENT	0005	R	006360	ETAT	0004	R	000002	FB
0005	R	006376	FBTC	0005	R	006367	FABC	0005	R	005111	FRL	0004	R	000001	GC
0005	R	003132	HI	0005	R	003036	HO	0011	R	000000	HPTCP	0012	R	000000	HPTCV
0005	R	003322	HRAO	0005	I	005110	ICHON	0003	I	000551	IPROP	0005	I	005052	ISPT
0005	I	003606	JUN	0003	R	003413	KA	0003	R	004561	MACH	0005	I	005066	MEX
0005	I	005102	MWC	0005	I	002552	NGR	0003	I	000553	NPLINE	0005	I	002646	NPR
0006	R	000000	OPTCP	0007	R	000000	OPTCV	0010	R	000000	OPTV	0000	R	000007	P
0005	R	004764	PC	0005	R	004772	PCH	0005	R	005074	PE	0005	R	000272	PG
0004	R	000000	PI	0005	R	005036	PMR	0005	R	006241	PQWC	0005	R	006350	POWP
0005	R	006300	PP1	0005	R	006305	PP0	0005	R	006331	PTI	0005	R	006336	PTO
0003	R	005754	RFLAG	0003	R	005711	RGAS	0005	R	001422	RHOG	0005	R	006312	RPMT
0000	R	000010	T	0005	R	005044	TC	0005	R	006416	THUC	0005	R	006411	TPCG
0003	R	001132	TEMP	0005	R	006317	TTI	0005	R	006324	TTO	0003	R	002262	TTTEMP
0005	R	006356	U	0005	R	003416	UAO	0005	R	003512	VEL	0003	R	000253	VISC
0005	R	006265	WI	0005	R	004750	WNOZ	0005	R	006253	WQ	0005	R	006351	WT
												0005	R	005060	CF
												0003	R	005714	CP
												0005	R	000036	DELXL
												0005	R	006370	F6PC
												0000	R	000012	GISO
												0013	R	000000	HPTV
												0000	I	000006	JJ
												0005	I	004756	MR
												0005	R	002742	NRE
												0005	R	000264	PB
												0005	R	003620	PGT
												0005	R	006343	PQWT
												0005	R	006357	R
												0003	R	000000	S
												0005	R	006404	TPCL
												0005	R	003226	TWALL
												0003	R	003423	WOUTG
												0005	R	006246	WTGC

0000 R 000000 X

0003 R 000413 XLENG

0000 R 000013 XX

0000 R 000014 YY

```

00100 10 C
00100 20 C ISOTHERMAL LINE SUBROUTINE
00100 30 C
00101 40 C SUBROUTINE ISOTH (II)
00101 50 C
00101 60 C
00103 70 C REAL NRE,MACH,KA
00103 80 C
00104 90 C DIMENSION X(6)
00104 100 C
00105 110 C DIMENSION VISC(30),XLENG(30),NPLINE(30),TTEMP(30,20),RGAS(2)
00105 120 C , TTTEMP(30,20),MACH(30,20),CP(30),KA(2),WDOTG(30,20)
00105 130 C
00106 140 C COMMON /INDATA/S(5000)
00106 150 C
00107 160 C COMMON /CONS/P1,GC,FB
00107 170 C
00110 180 C COMMON /COM/AREA(30),DELXL(30),AREAI(30),AREAO(30),AREAK(30)
00110 190 C , DIALI(30),PB(6),PG(30,20),RHOG(30,20),NGR(30,2)
00110 200 C , NPR(30,2),NRE(30,2),HO(30,2),HI(30,2),THALL(30,2)
00110 210 C , HRAD(30,2),UAO(30,2),VEL(30,2),JUN(10),PGT(30,20)
00110 220 C , WNOZ(6),MR(6),PC(6),PCN(6,2),CSTAR(6),CONCT(3,6)
00110 230 C , PMR(6),TC(6),ISPT(6),CF(6),MEX(6),PE(6),MAC(6),ICMON
00110 240 C , FRL(30,20),POWC(5),WTGC(5),WO(10),WI(10),DHVENT,PP(5)
00110 250 C , PPO(5),RPMT(5),TTI(5),TTO(5),PTI(5),PTO(5),POWT(5)
00110 260 C , POWP(5),CVEL,U,R,ETAT,WT,FBWC(6),FBPC(6)
00110 270 C , FBTC(6),TPCL(5),TPCG(5),THOC(5),CGGTC(6),CLTANK(5)
00110 280 C , CGTANK(5),CPJU(5,10)
00110 290 C
00111 300 C EQUIVALENCE
00111 310 C , (S(172),VISC(1)),(S(268),XLENG(1)),(S(362),IPROP)
00111 320 C , (S(364),NPLINE(1)),(S(603),TTEMP(1,1)),(S(1203),TTTEMP(1,1))
00111 330 C , (S(1812),WDOTG(1,1)),(S(2418),MACH(1,1)),(S(3018),RGAS(1))
00111 340 C , (S(3021),CP(1)),(S(1804),KA(1))
00111 350 C , (S(3053),RFLAG)
00111 360 C
00112 370 C JJ = 1
00112 380 C
00113 390 C IPROP = NPLINE(II)
00114 400 C P = PG(II,1)
00115 410 C T = TTEMP(II,1)
00116 420 C GO TO (1,2), IPROP
00116 430 C OXYGEN
00117 440 C 1 CP(1) = OPTCP(P,T)
00120 450 C CVGAS = OPTCV(P,T)
00121 460 C VISC(1) = OPTV(P,T) * 32.2 * 3600.
00122 470 C GO TO 5
00122 480 C HYDROGEN
00123 490 C 2 CP(1) = HPTCP(P,T)
00124 500 C CVGAS = HPTCV(P,T)
00125 510 C VISC(1) = HPTV(P,T) * 32.2 * 3600.
00126 520 C 5 KA(IPROP) = CP(1) / CVGAS
00127 530 C RGAS(IPROP) = ( CP(1) - CVGAS ) * 778.156

```



```

00130 54* VEL(II,JJ) = MACH(II,JJ)*SQRT(KA(IPROP)*GC*RGAS(IPROP)*TEMP(II,JJ)
00130 55* )
00131 56* TTTEMP(II,JJ) = TTTEMP(II,JJ)+VEL(II,JJ)**2/(2*GC*FB*CP(II))
00131 57* C DENSITY OF GAS
00132 58* RHOG(II,JJ) = PG(II,JJ)/(KGAS(IPROP)*TEMP(II,JJ))*144.0
00132 59* C REYNOLDS NUMBER
00133 60* NRE(II,JJ) = VEL(II,JJ)*DIALI(II)*RHOG(II,JJ)/(VISC(II)*12.0)
00133 61* C KOD FRICTION FACTOR FOR SMOOTH PIPES = PG.383 CHE. HANDBOOK EQ. 24
00134 62* FRL(II,JJ) = 1.4E-3 + 1.25E-1*(NRE(II,JJ))**(-0.32)
00134 63* C
00135 64* X(1) = PG(II,JJ)
00136 65* X(2) = FRL(II,JJ)
00137 66* X(3) = WDOTG(II,JJ)
00140 67* X(4) = TTTEMP(II,JJ)
00141 68* X(5) = DIALI(II)
00142 69* X(6) = XLENG(II)
00142 70* C
00143 71* CALL FCOMP2 (X,PG(II,2),GISU)
00143 72* C
00144 73* MACH(II,2) = MACH(II,1)*PG(II,1)/PG(II,2)
00145 74* TEMP(II,2) = TEMP(II,1)
00146 75* TTTEMP(II,2) = TTTEMP(II,2)*(1.0 + (KA(IPROP)-1)*0.5*MACH(II,2)**2)
00146 76* C FLOWRATE
00147 77* WDOTG(II,2) = WDOTG(II,1)
00147 78* C TOTAL PRESSURE
00150 79* XX = (1.0 + (KA(IPROP)-1.0)*0.5*MACH(II,JJ)**2) **
00150 80* (KA(IPROP)/(KA(IPROP)-1.0))
00151 81* YY = (1.0 + (KA(IPROP)-1.0)*0.5*MACH(II,JJ+1)**2) **
00151 82* (KA(IPROP)/(KA(IPROP)-1.0))
00152 83* PGT(II,JJ) = PG(II,JJ)*XX
00153 84* PGT(II,2) = PG(II,2)*YY
00153 85* C
00154 86* IF (RFLAG),20,
00154 87* C
00157 88* WRITE (6,10) II,JJ,II,JJ,IPROP,NPLINE(II),IPROP,IPROP,VEL(II,JJ),MA
00157 89* ZCH(II,JJ),KA(IPROP),GC,RGAS(IPROP),TEMP(II,JJ),TTTEMP(II,JJ),VISC
00157 90* 3(II),CP(II),RHOG(II,JJ),PG(II,JJ),NRE(II,JJ),WDOTG(II,1),WDOTG(II,
00157 91* 42),DIALI(II),XLENG(II),FB,X(1)
00213 92* 10 FORMAT(1H1//24X13HISOTH=ROUTINE/7X4I17/7X4I17/(7X1P4E17.7))
00213 93* C
00214 94* 20 RETURN
00215 95* END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

O *DIAGNOSTIC* MESSAGE(S)

150TH	CODE	SYMBOLIC	RELOCATABLE	23 JUN 71	21:25:51	0	01706542	14	95	(DELETED)
150TH	CODE	SYMBOLIC	RELOCATABLE	23 JUN 71	21:25:51	1	01711224	48	1	(DELETED)
6 HDG	6	FOR,*	JUNCL,JUNCL			0	01711304	14	33	

3.2.36 JUNC1 (10 WAY JUNCTION)

FOR, * JUNC1, JUNC1
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:40

31 AUG 71

9:27:40,765

SUBROUTINE JUNC1 ENTRY POINT 000404

STORAGE USED (BLOCK, NAME, LENGTH)

```

0001 *CODE 000422
0000 *DATA 000107
0002 *BLANK 000000
0003 INDATA 011610
0004 CONS 000003
0005 COM 006525

```

EXTERNAL REFERENCES (BLOCK, NAME)

```

0006 OPTCP
0007 HPTCP
0010 NWDUS
0011 N101S
0012 N102S
0013 NERR2S
0014 SQRT
0015 NERR3S

```

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000104 IL	0001 000051 11L	0001 000040 132G	0001 000057 143G	0001 000113 2L
0001 000174 20L	0001 000220 206G	0001 000323 236G	0001 000357 253G	0001 000307 30L
0001 000363 41L	0001 000121 5L	0001 000032 9L	0000 000021 9DOF	0000 000030 901F
0000 000036 902F	0005 R 000000 AREA	0005 R 000074 AREA1	0005 R 000170 AREAK	0005 R 000132 AREAO
0005 R 005060 CF	0005 R 006423 CGGTC	0005 R 006436 CGTANK	0005 R 006431 CLTANK	0005 R 005014 CONCT
0003 R 005714 CP	0005 R 006443 CPJU	0005 R 005006 CSTAR	0005 R 006355 CVEL	0005 R 000036 DELXL
0005 R 000226 DIALI	0005 R 006277 DMVENT	0005 R 006360 ETAT	0004 R 000002 FB	0005 R 006370 FBPC
0005 R 006376 FBTC	0005 R 006362 FBWC	0005 R 005111 FRL	0004 R 000001 GC	0005 R 003132 HI
0005 R 003036 HO	0007 R 000000 HPTCP	0005 R 003322 HRAD	0005 I 005110 ICHON	0000 I 000010 II
0003 I 000153 IJUNC	0000 I 000000 IO	0003 I 000551 IPROP	0005 I 005052 ISPT	0000 I 000002 IS
0000 I 000007 J	0000 I 000012 JJ	0000 I 000011 JL	0000 I 000020 JLI	0000 I 000017 JS
0005 R 003606 JUN	0003 R 003413 KA	0003 R 004561 MACH	0005 I 005066 MEX	0005 I 004756 MR
0005 I 005102 KWC	0000 I 000006 N	0005 I 002552 NGR	0003 I 010121 NLINJU	0003 I 000100 NODEL
0003 I 000553 NPLINE	0005 J 002646 NPR	0005 J 002742 NRE	0006 R 000000 OPTCP	0000 R 000013 P
0005 R 000264 PB	0005 R 004764 PC	0005 R 004772 PCN	0005 R 005074 PE	0005 R 000272 PG
0005 R 003620 PGT	0004 R 000000 PI	0000 R 000015 PJ	0005 R 005036 PHR	0005 R 006241 POWC
0005 R 006350 POWP	0005 R 006343 POWT	0005 R 006300 PPI	0005 R 006305 PPO	0000 R 000005 PSUM
0005 R 006331 PTI	0005 R 006336 PTO	0005 R 006357 R	0003 R 005754 RFLAG	0003 R 005711 RGAS
0005 R 001422 RHOG	0005 R 006312 RPMT	0003 R 000000 S	0000 R 000014 T	0005 R 005044 TC
0005 R 006416 THOC	0000 R 000016 TJ	0005 R 006411 TPCG	0005 R 006404 TPCL	0003 R 001132 TTEMP
0005 R 006317 TTI	0005 R 006324 TTO	0005 R 003226 THALL	0005 R 006356 U	0005 R 003416 UAO
0005 R 003512 VEL	0003 R 003423 WDOTG	0005 R 006266 WI	0000 R 000003 WM	0000 R 000004 WMT
0005 R 004750 WNOZ	0005 R 006253 WO	0005 R 006361 WT	0005 R 006246 WTCG	

```

00101 1. SUBROUTINE JUNC(1)
00101 2. C
00103 3. REAL JUN,MACH,KA
00103 4. C
00104 5. DIMENSION NLINJU(10),IJUNC(10,6),NPLINE(30),WDOTG(30,20)
00104 6. *,
00104 7. *,
00104 8. *,
00104 9. *,
00104 10. *,
00104 11. *,
00104 12. *,
00104 13. *,
00104 14. *,
00104 15. *,
00104 16. *,
00104 17. *,
00104 18. *,
00104 19. *,
00104 20. *,
00104 21. *,
00104 22. *,
00104 23. *,
00104 24. *,
00104 25. C
00104 26. EQUIVALENCE
00104 27. *,(S(4178),NLINJU(1)),(S(108),IJUNC(1)),(S(364),NPLINE(1))
00104 28. *,(S(1812),WDOTG(1,1)),(S(45),NODEL(1)),(S(362),IPROP)
00104 29. *,(S(403),TTEMP(1,1)),(S(2418),MACH(1,1)),(S(3018),RGAS(1))
00104 30. *,(S(1804),KA(1)),(S(3021),CP(1))
00104 31. *,(S(3053),RFLAG)
00104 32. DIMENSION IO(2)
00104 33. DATA IO / 6H IN ,6H OUT /
00104 34. C
00104 35. C INITIALIZE
00104 36. W(1) = 0.0
00104 37. W(1) = 0.0
00104 38. WM = 0.
00104 39. WMT = 0.
00104 40. PSUM = 0.
00104 41. IF (RFLAG).9,
00104 42. C HEADING
00104 43. WRITE (6,900) I
00104 44. 900 FORMAT (1H0, 20X, 24HJUNC-ROUTINE JUNCTION,13 )
00104 45. C
00104 46. C FIND J1 INLET LINES
00104 47. 9 N = NLINJU(1)
00104 48. DO 10 J=1,N
00104 49. I1 = IJUNC(I,J)
00104 50. IF (I1,LT,0) GO TO 11
00104 51. 10 CONTINUE
00104 52. I1 JL = J-1
00104 53. C
00104 54. C INLET LINES
00104 55. DO 20 J=1,JL
00104 56. I1 = IJUNC(I,J)

```

```

00146 57* JJ = NODEL(II)
00147 58* P = PG(II,JJ)
00150 59* T = TTEMP(II,JJ)
00151 60* IPROP = NPLINE(II)
00152 61* GO TO (1,2), IPROP
00153 62* 1 CP(II) = OPTCP(P,T)
00154 63* GO TO 5
00155 64* 2 CP(II) = HPTCP(P,T)
00156 65* 5 CONTINUE
00157 66* PSUM = PSUM + PG(II,JJ)
00160 67* WI(II) = WI(II) + WDOTG(II,JJ)
00161 68* WM = WM + WDOTG(II,JJ) * CP(II)
00162 69* WMT = WMT + WDOTG(II,JJ) * CP(II) * TTEMP(II,JJ)
00163 70* IF (RFLAG),20,
00166 71* WRITE (6,901) II,IO(1),WDOTG(II,JJ),PG(II,JJ),TTEMP(II,JJ),
00166 72* 1 CP(II), MACH(II,JJ)
00177 73* 901 FORMAT (1H,15X,4HLINE,13,A6,3E12.6,2F10.5 )
00200 74* 20 CONTINUE
00200 75* C
00202 76* PJ = PSUM / FLOAT(JL)
00203 77* TJ = WMT / WM
00203 78* C OUTLET LINES
00204 79* JS = JL + 1
00205 80* DO 30 J=JS,N
00210 81* II = -IJUNC(I,J)
00211 82* JJ = 1
00212 83* WO(II) = WO(II) + WDOTG(II,JJ)
00213 84* PG(II,JJ) = PJ
00214 85* TTEMP(II,JJ) = TJ
00215 86* MACH(II,1) = WDOTG(II,1)/(DIALI(II)*2*PG(II,1))*SQRT(RGAS
00215 87* (IPROP)*TTEMP(II,1)/(6.1685029E-10GC*KA(IPROP)))
00216 88* IF (RFLAG),30,
00221 89* WRITE (6,901) II,IO(2),WDOTG(II,JJ),PG(II,JJ),TTEMP(II,JJ),
00221 90* 1 CP(II),MACH(II,JJ)
00232 91* 30 CONTINUE
00232 92* C
00232 93* C INLET PIPE PRESSURE CONSTRAINT EQUATIONS
00234 94* JL1 = JL - 1
00235 95* DO 40 J=1,JL1
00240 96* II = IJUNC(I,J)
00241 97* JJ = NODEL(II)
00242 98* 40 CPJU(I,J) = 1. - PG(II,JJ)/PJ
00242 99* C
00242 100* C NET FLOWRATE CONSTRAINT EQUATION
00244 101* JUN(I) = 1. - WO(II)/WI(II)
00245 102* IF (RFLAG),41,
00250 103* WRITE (6,902) JUN(I),(CPJU(J,I),J=1,JL1)
00257 104* 902 FORMAT (1H,28HJUNCTION-ROUTINE CONSTRAINTS / 4X,6E10.4)
00260 105* 41 CONTINUE
00261 106* RETURN
00262 107* END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

JUNCL	CODE	SYMBOLIC	RELOCATABLE	31 AUG 71	09:25:10	0	02126742	14	107	(DELETED)
JUNCL				31 AUG 71	09:25:10	1	02131674	36	1	(DELETED)
B HDG	B	FOR,*	LATENT,LATENT			0	02131740	14	34	

FOR, LATENT, LATENT
 UNIVAC 1108 FORTRAN V LEVEL 2205 0018 F5G18H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:43

31 AUG 71

9:27:42.901

SUBROUTINE LATENT ENTRY POINT 000056

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000075
 0000 *DATA 000202
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 BETA
 0004 NERR2S
 0005 NERR3S

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME).

0001	000010	10L	0001	000031	20L	0003	R	000000	BETA	0000	R	000024	HGH	0000	R	000120	HGO		
0000	R	000000	HLH	0000	R	000074	HLO	0000	I	000170	IS	0000	I	000171	NPH	0000	I	000172	NPO
0000	R	000050	PH	0000	R	000144	PO												

140

```

00101 1* SUBROUTINE LATENT ( IFLUID, PX, ENTHL, ENTHG )
00101 2* C
00101 3* C OBTAIN SATURATED LIQ AND SAT. GAS ENTHALPIES AT INPUT PX
00101 4* C BY LINEAR INTERPOLATION IN SAT. ENTHALPY-PRESSURE TABLES
00101 5* C
00103 6* DIMENSION HLH(20), HGH(20), PH(20), HLO(20), HGO(20), PO(20)
00104 7* DATA HLH / -115.02, -109.91, -106.06, -97.32, -90.61, -84.51,
00104 8* 1 -78.80, -73.35, -68.06, -62.86, -57.71, -30.35, 8.00 /
00106 9* DATA HGH / 78.51, 81.78, 84.17, 86.78, 87.97, 88.30, 88.04,
00106 10* 1 87.34, 86.26, 84.88, 83.21, 70.59, 8.00 /
00110 11* DATA NPH / 12, PH / 10, 14.696, 20, 30, 40, 50, 60, 70,
00110 12* 1 80, 90, 100, 150, 8.00 /
00113 13* DATA HLO / -48.022, -45.913, -43.781, -41.623, -39.434, -37.211,
00113 14* 1 -34.947, -32.636, -30.270, -27.840, -25.313, -22.697, -19.975,
00113 15* 2 -17.124, -14.099, -10.836, -7.226, -3.032, 2.462, 14.030 /
00115 16* DATA HGO / 37.508, 38.097, 38.622, 39.079, 39.464, 39.769,
00115 17* 1 39.990, 40.117, 40.143, 40.056, 39.840, 39.479, 38.945, 38.203,
00115 18* 2 37.197, 35.836, 33.951, 31.136, 26.465, 14.030 /
00117 19* DATA NPO / 20, PO / 46.261, 57.286, 70.163, 85.040, 102.09,
00117 20* 1 121.51, 143.49, 168.20, 195.82, 226.59, 260.66, 298.26, 339.62,
00117 21* 2 384.96, 434.55, 488.66, 547.69, 612.08, 683.06, 737.06 /
00117 22* C
00122 23* GO TO (10, 20), IFLUID
00123 24* 10 ENTHL = BETA ( HLH, PH, PX, NPH )
00124 25* ENTHG = BETA ( HGH, PH, PX, NPH )
00125 26* RETURN

```

FOR,* LATENT,LATENT

DATE 310871 PAGE 200

00126 27* 20 ENTHL = BETA (HLO, PO, PX, NPO)
 00127 28* ENTHG = BETA (HGO, PO, PX, NPO)
 00130 29* RETURN
 00131 30* END

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

LATENT SYMBOLIC
 LATENT CODE RELOCATABLE

14 JUN 71	15:04:54	0	01603246	14	30	(DELETED)
14 JUN 71	15:04:54	1	01604112	24	1	(DELETED)
		0	01604142	14	18	

@ HOG @ FOR,* LEGS,LEGS

FOR, LEGS, LEGS
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 FSG18H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:44

31 AUG 71

9:27:43,985

SUBROUTINE LEGS ENTRY POINT 001521

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 001603
0000 *DATA 000155
0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR2\$
0004 NERR3\$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000033	1L	0001	000144	10L	0001	000100	127G	0001	000211	13L	0001	000111	134G
0001	000216	14L	0001	000122	142G	0001	000152	160G	0001	000165	164G	0001	000235	17L
0001	000247	20L	0001	000227	205G	0001	000265	21L	0001	000244	217G	0001	000273	22L
0001	000312	246G	0001	000350	25L	0001	000357	27L	0001	000454	3L	0001	000376	30L
0001	000405	31L	0001	000413	32L	0001	000417	33L	0001	000432	35L	0001	000444	36L
0001	000452	37L	0001	000480	38L	0001	000471	39L	0001	000501	40L	0001	000525	402L
0001	000540	404L	0001	000553	406L	0001	000566	42L	0001	000645	420G	0001	000571	43L
0001	000676	435G	0001	000710	443G	0001	000607	46L	0001	000760	465G	0001	000614	47L
0001	000772	472G	0001	000633	49L	0001	000640	50L	0001	001036	510G	0001	000665	53L
0001	001146	536G	0001	000753	55L	0001	001172	551G	0001	001244	571G	0001	000102	6L
0001	001261	602G	0001	001111	61L	0001	001307	610G	0001	001137	63L	0001	001366	637G
0001	001403	645G	0001	001423	654G	0001	001205	67L	0001	000116	7L	0001	001230	71L
0001	001276	74L	0001	001361	79L	0001	001451	792L	0001	001473	82L	0001	000142	9L
0000 R	000042	D	0000 R	000040	D1	0000 R	000041	D2	0000 R	000017	E1	0000 R	000020	E2
0000 R	000025	H	0000 R	000030	HAL	0000 I	000006	I	0000 I	000022	ICT	0000 I	000023	IF
0000 I	000021	IMAX	0000 I	000061	IN	0000 I	000005	IP	0000 I	000004	IQ	0000 I	000060	IR
0000 I	000055	IRS	0000 I	000054	IRSS	0000 I	000010	IS	0000 I	000057	IT	0000 I	000056	ITS
0000 I	000001	J	0000 I	000007	K	0000 I	000053	KK	0000 I	000027	KL	0000 I	000050	KL1
0000 I	000045	KM	0000 I	000026	KT	0000 I	000044	K1	0000 I	000047	K2	0000 I	000011	L
0000 I	000012	LI	0000 I	000013	LJ	0000 I	000002	N	0000 I	000000	NIDLE	0000 I	000003	N2
0000 R	000016	RH1	0000 R	000015	RHV	0000 R	000046	S	0000 R	000051	SS	0000 R	000052	S1
0000 R	000043	TP	0000 R	000014	X	0000 R	000031	X1	0000 R	000032	X1AL	0000 R	000034	X2
0000 R	000036	X3	0000 R	000024	Y	0000 R	000033	Y1	0000 R	000035	Y2	0000 R	000037	Y3

00101 1* SUBROUTINE LEGS (AB, OPAR, BNDS, M, NI, MD, NO, ATA, R, Z,
00101 2* X SUS, SUSP, I1, I2, I3, I4, I5, IDLE)
00101 3* C MODIFIED MAY 1968
00103 4* DIMENSION AB(2), OPAR(2), BNDS(2), ATA(2), R(2), IDLE(2)
00104 5* ABC(D)=ABS(D)
00104 6* C TO CONVERT TO DOUBLE PRECISION DELETE THE PRECEDING CARD
00104 7* C AND REMOVE THE COLUMN 1 C FROM THE NEXT 3 CARDS

LEGS0001
LEGS0002
LEGS0003
LEGS0004
LEGS0005
LEGS0006
LEGS0007

```

00104 80 C DOUBLE PRECISION AB,DPAR,BNDS,ATA,R,Z,SUS,SUSP,D1,D2,D LEGS0008
00104 90 C 1,E1,E2,H,HAL,RH1,RHV,S1,S,SS,X1,X2,X3,X,Y1,Y2,Y3,Y,XIAL,TP LEGS0009
00104 100 C ABC(D)=DABS(D) LEGS0010
00105 110 LEGS0011
00105 120 C COUNT THE NUMBER OF DELETIONS LEGS0012
00105 130 LEGS0013
00105 140 NIDLE=0 LEGS0014
00106 150 J=1 LEGS0015
00107 160 1 IF(IDLE(J))3,3,2 LEGS0016
00112 170 2 NIDLE=NIDLE+1 LEGS0017
00113 180 J=J+2 LEGS0018
00114 190 IF(J=200)1,1,3 LEGS0019
00117 200 LEGS0020
00117 210 C SET UP COUNTERS LEGS0021
00117 220 LEGS0022
00117 230 3 N=N1 LEGS0023
00120 240 N2=N+1 LEGS0024
00121 250 IQ=(N*N2)/2 LEGS0025
00122 260 IP=(N2*(N2+1))/2 LEGS0026
00123 270 LEGS0027
00123 280 LEGS0028
00123 290 C BRANCH ON I3 LEGS0029
00123 300 LEGS0030
00123 310 C I3 LESS THAN ZERO -- COMPUTE ATA AND ADD IT TO CONTENTS OF ATA LEGS0031
00123 320 C I3 EQUAL TO ZERO -- COMPUTE ATA AND PUT IN CLEARED ATA LEGS0032
00123 330 C I3 GREATER THAN ZERO -- ATA CALCULATED BEFORE ENTRY LEGS0033
00123 340 LEGS0034
00123 350 LEGS0035
00123 360 IF(I3)6,4,14 LEGS0036
00126 370 4 DO 5 I=1,IP LEGS0037
00131 380 5 ATA(I)=0 LEGS0038
00133 390 6 DO 13 K=1,M LEGS0039
00136 400 IF(NIDLE)10,10,7 LEGS0040
00141 410 LEGS0041
00141 420 C ROW DELETOR SECTION LEGS0042
00141 430 LEGS0043
00141 440 7 DO 9 J=1,NIDLE LEGS0044
00144 450 IS=20J LEGS0045
00145 460 IF(K-IDLE(IS-1))9,13,8 LEGS0046
00150 470 8 IF(K-IDLE(IS))13,13,9 LEGS0047
00153 480 9 CONTINUE LEGS0048
00155 490 LEGS0049
00155 500 C COMPUTE ATA LEGS0050
00155 510 LEGS0051
00155 520 10 L=1 LEGS0052
00156 530 LI=K LEGS0053
00157 540 DO 12 I=1,N2 LEGS0054
00162 550 LJ=LI LEGS0055
00163 560 DO 11 J=1,N2 LEGS0056
00166 570 ATA(L)=ATA(L)+AB(LI)*AB(LJ) LEGS0057
00167 580 L=L+1 LEGS0058
00170 590 11 LJ=LJ+MD LEGS0059
00172 600 12 LI=LI+MD LEGS0060
00174 610 13 CONTINUE LEGS0061
00176 620 LEGS0062
00176 630 LEGS0063
00176 640 C BRANCH ON I5 LEGS0064
00176 650 LEGS0065

```



```

00176 66° C 15 EQUAL TO ZERO -- CONTINUE
00176 67° C 15 NOT EQUAL TO ZERO -- EXIT
00176 68°
00176 69°
00176 70° IF (15) 82, 14, 82
00201 71°
00201 72°
00201 73° C BRANCH ON 12
00201 74°
00201 75° C 12 EQUAL TO ZERO -- SOLVE FOR X
00201 76° C 12 NOT EQUAL TO ZERO -- DO NOT SOLVE FOR X
00201 77°
00201 78°
00201 79° 14 IF (12) 15, 17, 15
00204 80° 15 DO 16 I=1, N
00207 81° 16 DPAR(I)=BND5(I)
00211 82° X=1.
00212 83° GO TO 71
00213 84°
00213 85°
00213 86° C BRANCH ON 11
00213 87°
00213 88° C 11 EQUAL TO ZERO -- NO BOUNDS IN SOLVING FOR X
00213 89° C 11 NOT EQUAL TO ZERO -- BOUNDS USED IN SOLVING FOR X
00213 90°
00213 91° 17 IF (11) 20, 18, 20
00216 92° 18 DO 19 I=1, N
00221 93° 19 BND5(I)=-1.
00223 94°
00223 95° C INITIALIZING FOR ITERATION
00223 96°
00223 97° 20 RHV=.0001
00224 98° RH1=.2
00225 99° E1=.1
00226 100° E2=.2
00227 101° IMAX=20
00230 102° ICT=0
00231 103° A=0.
00232 104° IF=1
00233 105°
00233 106° C FIND UNBOUNDED SOLUTION
00233 107°
00233 108° GO TO 47
00234 109°
00234 110° C IF CONSTRAINTS SATISFIED, EXIT ITERATION
00234 111°
00234 112° 21 IF (Y-E1) 71, 71, 22
00237 113°
00237 114° C GET FIRST ESTIMATE FOR ITERATION
00237 115°
00237 116° 22 H=0.
00240 117° KT=1
00241 118° KL=N2
00242 119° IF=2
00243 120° K=KT+KL-1
00244 121° HAL=0.0
00245 122° DO 28 I=1, N
00250 123° IF (BND5(I)) 27, 27, 23

```

```

LEGS0068
LEGS0069
LEGS0070
LEGS0071
LEGS0072
LEGS0073
LEGS0074
LEGS0075
LEGS0076
LEGS0077
LEGS0078
LEGS0079
LEGS0080
LEGS0081
LEGS0082
LEGS0083
LEGS0084
LEGS0085
LEGS0086
LEGS0087
LEGS0088
LEGS0089
LEGS0090
LEGS0091
LEGS0092
LEGS0093
LEGS0094
LEGS0095
LEGS0096
LEGS0097
LEGS0098
LEGS0099
LEGS0100
LEGS0101
LEGS0102
LEGS0103
LEGS0104
LEGS0105
LEGS0106
LEGS0107
LEGS0108
LEGS0109
LEGS0110
LEGS0111
LEGS0112
LEGS0113
LEGS0114
LEGS0115
LEGS0116
LEGS0117
LEGS0118
LEGS0119
LEGS0120
LEGS0121
LEGS0122
LEGS0123

```

00253	124*	23	X1=ABC(ATA(K))	LEGS0124
00254	125*		X1=BND5(I)*2*(X1/BND5(I)-ATA(KT))	LEGS0125
00255	126*		X1AL=ATA(KT)*BND5(I)*2*RHV	LEGS0126
00256	127*		IF(X1AL-HAL)25,25,24	LEGS0127
00261	128*	24	HAL=X1AL	LEGS0128
00262	129*	25	IF(X1-H)27,27,26	LEGS0129
00265	130*	26	H=X1	LEGS0130
00266	131*	27	KT=KT+KL	LEGS0131
00267	132*		KL=KL-1	LEGS0132
00270	133*	28	K=K+KL	LEGS0133
00272	134*		IF(H)29,29,30	LEGS0134
00275	135*	29	H=HAL	LEGS0135
00276	136*			LEGS0136
00276	137*	C	SET X1=FIRST ESTIMATE	LEGS0137
00276	138*			LEGS0138
00276	139*	30	X1=X	LEGS0139
00277	140*		Y1=Y	LEGS0140
00300	141*		X=X+H	LEGS0141
00301	142*		GO TO 47	LEGS0142
00302	143*	31	IF(Y-E1)33,33,32	LEGS0143
00305	144*			LEGS0144
00305	145*	C	X IS TOO SMALL INCREASE AND TRY AGAIN	LEGS0145
00305	146*			LEGS0146
00305	147*	32	H=10.*H	LEGS0147
00306	148*		GO TO 30	LEGS0148
00307	149*			LEGS0149
00307	150*	C	SOLUTION IS BETWEEN X1 AND X.	LEGS0150
00307	151*	C	IF X IS GOOD ENOUGH, EXIT ITERATION	LEGS0151
00307	152*			LEGS0152
00307	153*	33	IF(Y+E2)34,71,71	LEGS0153
00312	154*	34	X2=X	LEGS0154
00313	155*		Y2=Y	LEGS0155
00314	156*		IF=3	LEGS0156
00315	157*			LEGS0157
00315	158*	C	SOLUTION IS BETWEEN X1 AND X2. TRY A POINT IN BETWEEN.	LEGS0158
00315	159*			LEGS0159
00315	160*	35	X=(1.-RHI)*X1+RHI*X2	LEGS0160
00316	161*		IF=3	LEGS0161
00317	162*		GO TO 47	LEGS0162
00320	163*	36	IF(Y-E1)37,37,39	LEGS0163
00323	164*			LEGS0164
00323	165*	C	IF X IS GOOD ENOUGH, EXIT ITERATION	LEGS0165
00323	166*			LEGS0166
00323	167*	37	IF(Y+E1)38,71,71	LEGS0167
00326	168*			LEGS0168
00326	169*	C	SOLUTION IS BETWEEN X1 AND X.	LEGS0169
00326	170*			LEGS0170
00326	171*	38	X3=X2	LEGS0171
00327	172*		Y3=Y2	LEGS0172
00330	173*		X2=X	LEGS0173
00331	174*		Y2=Y	LEGS0174
00332	175*			LEGS0175
00332	176*	C	SOLUTION IS BETWEEN X1 AND X2. X3 BIGGER THAN X2	LEGS0176
00332	177*			LEGS0177
00332	178*		GO TO 40	LEGS0178
00333	179*			LEGS0179
00333	180*	C	SOLUTION IS BETWEEN X AND X2	LEGS0180
00333	181*			LEGS0181

00333	182*	39	X3=X1	LEGS0182
00334	183*		Y3=Y1	LEGS0183
00335	184*		X1=X	LEGS0184
00336	185*		Y1=Y	LEGS0185
00337	186*			LEGS0186
00337	187*	C	SOLUTION IS BETWEEN X1 AND X2. X3 LESS THAN X1	LEGS0187
00337	188*			LEGS0188
00337	189*		40 U1=Y2-Y1	LEGS0189
00340	190*			LEGS0190
00340	191*	C	DO INVERSE QUADRATIC INTERPOLATION TO GET NEXT POINT	LEGS0191
00340	192*			LEGS0192
00340	193*		D2=Y3-Y2	LEGS0193
00341	194*		D=Y3-Y1	LEGS0194
00342	195*		X=0,	LEGS0195
00343	196*		TP=D1*0	LEGS0196
00344	197*		IF (TP) 401, 402, 401	LEGS0197
00347	198*	401	X=X+(X1*Y2+Y3)/TP	LEGS0198
00350	199*	402	TP=D1*D2	LEGS0199
00351	200*		IF (TP) 403, 404, 403	LEGS0200
00354	201*	403	X=X-(X2*Y1+Y3)/TP	LEGS0201
00355	202*	404	TP=D*D2	LEGS0202
00356	203*		IF (TP) 405, 406, 405	LEGS0203
00361	204*	405	X=X+(X3*Y1+Y2)/TP	LEGS0204
00362	205*	406	CONTINUE	LEGS0205
00363	206*			LEGS0206
00363	207*	C	IF INTERPOLATED POINT IS OUTSIDE RANGE (X1,X2),	LEGS0207
00363	208*	C	TRY A NEW POINT BETWEEN X1 AND X2	LEGS0208
00363	209*			LEGS0209
00363	210*		IF (X-X2) 41, 35, 35	LEGS0210
00366	211*	41	IF (X-X1) 35, 35, 42	LEGS0211
00371	212*			LEGS0212
00371	213*	C	INTERPOLATED POINT IS WITHIN RANGE (X1,X2)	LEGS0213
00371	214*			LEGS0214
00371	215*	42	IF=4	LEGS0215
00372	216*		GO TO 47	LEGS0216
00373	217*			LEGS0217
00373	218*	C	IF X IS GOOD ENOUGH, EXIT ITERATION	LEGS0218
00373	219*			LEGS0219
00373	220*	43	IF (Y-E1) 44, 44, 46	LEGS0220
00376	221*	44	IF (Y+E2) 45, 71, 71	LEGS0221
00401	222*	45	X2=X	LEGS0222
00402	223*			LEGS0223
00402	224*	C	SOLUTION IS BETWEEN X1 AND NEW X2	LEGS0224
00402	225*			LEGS0225
00402	226*		Y2=Y	LEGS0226
00403	227*		GO TO 35	LEGS0227
00404	228*	46	X1=X	LEGS0228
00405	229*		Y1=Y	LEGS0229
00406	230*			LEGS0230
00406	231*	C	SOLUTION IS BETWEEN NEW X1 AND X2	LEGS0231
00406	232*			LEGS0232
00406	233*		GO TO 35	LEGS0233
00407	234*			LEGS0234
00407	235*	C	SOLVING THE LINEAR SYSTEM	LEGS0235
00407	236*	C	DECOMPOSE X SUBMATRIX	LEGS0236
00407	237*			LEGS0237
00407	238*	47	K(1)=-1.	LEGS0238
00410	239*		R(IP+1)=0.	LEGS0239

```

00411 240*      L=1                      LEGS0240
00412 241*      IF(BNDS(1))49,50,48    LEGS0241
00415 242*      48 R(IP+1)=X/BNDS(1)**2 LEGS0242
00416 243*      LEGS0243
00416 244*      C COMPUTE FIRST ELEMENT OF D. LEGS0244
00416 245*      LEGS0245
00416 246*      49 R(IP+1)=ATA(1)+R(IP+1) LEGS0246
00417 247*      50 DO 62 K=1,N          LEGS0247
00422 248*      LEGS0248
00422 249*      C DECOMPOSE (K+1)X(K+1) SUBMATRIX LEGS0249
00422 250*      LEGS0250
00422 251*      IF(K=N)51,53,53        LEGS0251
00425 252*      51 IF(BNDS(K+1))53,52,53 LEGS0252
00430 253*      52 K1=IP+K+1           LEGS0253
00431 254*      R(K1)=0.               LEGS0254
00432 255*      GO TO 61               LEGS0255
00433 256*      53 KL=1                LEGS0256
00434 257*      DO 55 J=1,K            LEGS0257
00437 258*      KM=K+1                 LEGS0258
00440 259*      KT=N                   LEGS0259
00441 260*      S=0.                   LEGS0260
00442 261*      DO 54 I=1,J            LEGS0261
00445 262*      S=S+R(KL)*ATA(KM)     LEGS0262
00446 263*      KM=KM+KT               LEGS0263
00447 264*      KT=KT+1                LEGS0264
00450 265*      54 KL=KL+1             LEGS0265
00452 266*      K1=L+J                 LEGS0266
00453 267*      K2=IP+J                LEGS0267
00454 268*      R(K1)=0.               LEGS0268
00455 269*      IF(R(K2))541,55,541'   LEGS0269
00460 270*      541 R(K1)=S/R(K2)       LEGS0270
00461 271*      55 CONTINUE            LEGS0271
00463 272*      KL=0                   LEGS0272
00464 273*      DO 57 J=1,K            LEGS0273
00467 274*      KL1=KL+J               LEGS0274
00470 275*      S=0.                   LEGS0275
00471 276*      DO 56 I=J,K             LEGS0276
00474 277*      K1=L+I                 LEGS0277
00475 278*      S=S+R(KL1)*R(K1)       LEGS0278
00476 279*      56 KL1=KL1+1            LEGS0279
00500 280*      K1=L+J                  LEGS0280
00501 281*      KL=KL+J                 LEGS0281
00502 282*      57 R(K1)=S              LEGS0282
00504 283*      KL=K+1                  LEGS0283
00505 284*      KT=N                    LEGS0284
00506 285*      S=0.                    LEGS0285
00507 286*      DO 58 J=1,K             LEGS0286
00512 287*      K1=L+J                  LEGS0287
00513 288*      S=S+R(K1)*ATA(KL)       LEGS0288
00514 289*      KL=KL+KT                LEGS0289
00515 290*      58 KT=KT+1              LEGS0290
00517 291*      K1=IP+K+1               LEGS0291
00520 292*      R(K1)=ATA(KL)-S          LEGS0292
00521 293*      IF(K=N)59,61,61         LEGS0293
00524 294*      59 IF(BNDS(K+1))61,61,60 LEGS0294
00527 295*      60 R(K1)=R(K1)+X/(BNDS(K+1))**2 LEGS0295
00530 296*      61 L=L+K+1              LEGS0296
00531 297*      R(L)=-1.                LEGS0297

```

```

00532 298* 62 CONTINUE
00534 299* GO TO(63,63,63,63,79),IF
00535 300* 63 DO 64 I=1,N
00540 301* K1=1Q+I
00541 302* 64 DPAR(I)=R(K1)
00543 303* ICT=ICT+1
00544 304* IF(ICT-IMAX)65,71,71
00547 305* 65 S=0.
00550 306* DO 67 I=1,N
00553 307* IF(BND5(I))67,67,66
00556 308* 66 S=S+(DPAR(I)/BND5(I))*2
00557 309* 67 CONTINUE
00561 310* 68 Y=S-1.
00562 311* 69 Z=X
00563 312* 70 GO TO(21,31,36,43,79),IF

```

C FIND LENGTH OF RESIDUAL VECTOR

```

00564 313* 71 SS=0.
00564 314* S1=0.
00565 317* K1=N2
00566 318* K2=N
00567 319* DO 76 J=1,N
00570 320* L=J
00573 321* S=0.
00574 322* KK=J-1
00575 323* IF(KK)74,74,72
00576 324* 72 DO 73 I=1,KK
00601 325* S=S+ATA(L)*DPAR(I)
00604 326* 73 L=L+N2-I
00605 327* 74 DO 75 I=J,N
00607 328* S=S+ATA(L)*DPAR(I)
00612 329* L=L+1
00613 330* SS=SS+S*DPAR(J)
00615 331* S1=S1+ATA(K1)*DPAR(J)
00616 332* K1=K1+K2
00617 333* 76 K2=K2-1
00620 334* SUS=ATA(K1)
00622 335* SUSP=SUS-2.*S1+SUS
00623 336*
00624 337*
00624 338*
00624 339*

```

C BRANCH ON 14

```

00624 340* C 14 EQUAL TO ZERO == INVERT NORMAL MATRIX
00624 341* C 14 NOT EQUAL TO ZERO == DO NOT INVERT NORMAL MATRIX,EXIT
00624 342*
00624 343* IF(14)82,77,82
00624 344* 77 IF(X)78,79,78
00627 345* 78 K=0.
00632 346* IF=5
00633 347* GO TO 47
00634 348*
00635 349*

```

C FIND THE INVERSE OF (A TRANSPOSE)*A

```

00635 350* 79 IRSS=0
00635 351* DO 81 K=1,N
00636 352* IRSS=IRSS+K
00641 353* IRSS=IRSS-K
00642 354*

```

```

LEGS0278
LEGS0279
LEGS0300
LEGS0301
LEGS0302
LEGS0303
LEGS0304
LEGS0305
LEGS0306
LEGS0307
LEGS0308
LEGS0309
LEGS0310
LEGS0311
LEGS0312
LEGS0313
LEGS0314
LEGS0315
LEGS0316
LEGS0317
LEGS0318
LEGS0319
LEGS0320
LEGS0321
LEGS0322
LEGS0323
LEGS0324
LEGS0325
LEGS0326
LEGS0327
LEGS0328
LEGS0329
LEGS0330
LEGS0331
LEGS0332
LEGS0333
LEGS0334
LEGS0335
LEGS0336
LEGS0337
LEGS0338
LEGS0339
LEGS0340
LEGS0341
LEGS0342
LEGS0343
LEGS0344
LEGS0345
LEGS0346
LEGS0347
LEGS0348
LEGS0349
LEGS0350
LEGS0351
LEGS0352
LEGS0353
LEGS0354
LEGS0355

```

IF FOR,• LEGS,LEGS

DATE 310871 PAGE 208

00643	356•	ITS=IRSS	LEGS0356
00644	357•	DO 81 J=K,N	LEGS0357
00647	358•	IRS=IRS+J	LEGS0358
00650	359•	IT=ITS	LEGS0359
00651	360•	IR=IRS	LEGS0360
00652	361•	S=0.	LEGS0361
00653	362•	DO 80 I=J,N	LEGS0362
00656	363•	IN=IP+I	LEGS0363
00657	364•	IF(R(IN))791,792,791	LEGS0364
00662	365•	791 S=S+(R(IT)*R(IR))/R(IN)	LEGS0365
00663	366•	792 IT=IT+I	LEGS0366
00664	367•	80 IR=IR+I	LEGS0367
00666	368•	R(ITS)=S	LEGS0368
00667	369•	81 ITS=ITS+J	LEGS0369
00672	370•	82 RETURN	LEGS0370
00673	371•	END	LEGS0371

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

LEGS SYMBOLIC

30 APR 71	11:19:50	0	01476042	14	371	(DELETED)
30 APR 71	11:19:50	1	01510154	24	1	(DELETED)
		0	01510204	14	93	

LEGS CODE RELOCATABLE

• HDG • FOR,• NUSLET,NUSLET

% FOR, NUSLET,NUSLET
 UNIVAC 1108 FORTRAN V LEVEL 2200 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:48

31 AUG 71

9:27:48. 32

SUBROUTINE NUSLET ENTRY POINT 000130

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000156
0000	*DATA	000105
0002	*BLANK	000000
0003	HEAT	001074

EXTERNAL REFERENCES (BLOCK, NAME)

0004	INTERP
0005	INTER2
0006	NERR25
0007	NEAP05
0010	NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000024	100L	0001	000041	200L	0001	000060	300L	0000 R 000011	APH11	0000 R 000000	ATB
0000 R	000033	BPH13	0000 R	000023	BTB	0000 R	000030	BTB	0003 R 000002	CP1	0003 R 000027	CPO
0000 R	000052	C1	0000 R	000053	C2	0003 R	000054	DIST	0003 R 000101	HE	0003 R 000720	H1
0003 R	000772	H0	0003 R	000745	HW	0000 I	000022	IS	0003 I 000126	K1	0000 I 000054	KKK
0003 I	000153	K0	0003 I	000200	KW	0003 I	000225	MU1	0003 I 000252	MU0	0003 R 001071	PH11
0003 R	001072	PH12	0003 R	001073	PH13	0003 R	000277	PI	0003 R 000324	PO	0003 R 000351	PR1
0003 R	000376	PRO	0003 R	000423	Q	0003 R	001017	QUAL1	0003 R 001044	QUAL0	0003 R 000450	RE1
0003 R	000475	RE0	0003 R	000522	SV1	0003 R	000547	SVO	0003 R 000574	T1	0003 R 000621	TO
0003 R	000646	TA1	0003 R	000673	TW0	0003 R	000000	%D				

150

```

00101 1* SUBROUTINE NUSLET (N,PR,RE,TA,TB,MART,NU)
00103 2* REAL NU,MART
00103 3* CC N=FLUID NUMBER, N=1 FOR HYDROGEN
00103 4* CC N=2 FOR OXYGEN
00103 5* CC N=3 FOR H2O-H2,MK=1.0
00103 6* CC INPUT RE = REYNOLDS NUMBER BULK
00103 7* CC PR = BULK PRANDTL NUMBER
00103 8* CC TA = WALL TEMP (DEG R)
00103 9* CC TB = BULK TEMP (DEG R)
00103 10* CC OUTPUT NU = NUSSET NUMBER
00103 11* CC
00103 12* CC PH11 CORRELATION DATA FOR HYDROGEN (PH11 VS. TB)
00104 13* DIMENSION ATB(9),APH11(9)
00104 14* C
00105 15* COMMON /HEAT/AD(2),CPI(21),CPU(21),DIST(21),HE(21),K1(21),KU(21)
00105 16* 1, KA(21),MUI(21),MUO(21),PI(21),PO(21),PRI(21),PRU(21)
00105 17* 2, Q(21),REF1(21),REU(21),SV1(21),SVO(21),TI(21),TV(21)

```

@ FOR,* NUSLET,NUSLET

DATE 310871 PAGE 210

```

00105 18* 3, TW1(21),TWO(21),HI(21),HW(21),HO(21)
00105 19* 4, QUAL1(21), QUAL0(21)
00105 20* 4, PH11,PH12,PH13
00105 21* C
00106 22* DATA ATB/40.0,50.0,60.0,70.0,80.0,90.0,100.0,110.0,120.0/
00110 23* DATA APH11/1.0, 1.0, 0.38, 0.51, 0.70, 0.80, 0.92, 0.96, 1.0/
00110 24* CC
00110 25* CC PH13 VS. TW AND TB CORRECTION DATA FOR OXYGEN
00112 26* DIMENSION BTB(5),BTW(3),BPH13(5,3)
00113 27* DATA BTB/200.0, 278.0, 300.0, 350.0, 400.0/
00115 28* DATA BTW/600.0, 1000.0, 1800.0/
00117 29* DATA BPH13/1.30, 0.58, 0.68, 0.836, 1.0,
00117 30* 10.95, 0.42, 0.556, 0.764, 1.0,
00117 31* 20.75, 0.32, 0.434, 0.655, 1.0/
00121 32* PH11=1.0
00122 33* PH12=1.0
00123 34* PH13=1.0
00124 35* C1 = 0.023
00125 36* C2 = 0.
00126 37* IF (MART .GT. 0.) GO TO 300
00130 38* GO TO (100,200,100),N
00131 39* 100 CONTINUE
00131 40* CC CORRELATION FOR HYDROGEN
00131 41* CC CORRELATION FOR H2O-H2 AT LOW MIXTURE RATIOS
00132 42* C1=0.025
00133 43* C2=-0.55
00133 44* C IF(RE.GT.5.0E+5) PH12=0.9
00134 45* CALL INTERP (9,ATB,APH11,TB,PH11,KKK)
00135 46* GO TO 300
00136 47* 200 CONTINUE
00136 48* CC CORRELATION FOR OXYGEN
00137 49* C1=0.023
00140 50* C2=-0.34
00141 51* CALL INTER2 (TB,BTB,TW,BTW,PH13,BPH13,5,3)
00142 52* GO TO 300
00143 53* 300 CONTINUE
00144 54* NU=C1*RE**0.8*PR**0.4*(TW/TB)**C2*PH11*PH12*PH13
00145 55* IF (MART .GT. 0.) NU =NU/(.611+1.93*MART)
00147 56* RETURN
00150 57* END

```

151

END OF UNIVAC 1108 FORTRAN V COMPILATION. 0 *DIAGNOSTIC* MESSAGE(S)
NUSLET SYMBOLIC 14 JUN 71 15:05:43 0 01667014 14 57 (DELETED)
NUSLET CODE RELOCATABLE 14 JUN 71 15:05:43 1 01670452 24 1 (DELETED)

0 01670502 14 17

@ HDG @ FOR,* OUTPRC,OUTPRC

FOR, * OUTPRC, OUTPRC
 UNIVAC 1108 FORTRAN V LEVEL 2206 0518 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:49

31 AUG 71

9:27:49.521

SUBROUTINE OUTPRC ENTRY POINT 002333

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	002343
0000	*DATA	000532
0002	*BLANK	000000
0003	INDATA	011610
0004	COM	006525
0005	TKOUT	000074

EXTERNAL REFERENCES (BLOCK, NAME)

0006	WRITE
0007	NADUS
0010	NIOIS
0011	NIOZS
0012	NERR3S

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000103	10L	0001	001505	100L	0000	000171	1000F	0000	000202	1010F	0001	001552	102L					
0000	000216	1020F	0000	000233	1030F	0000	000236	1040F	0000	000247	1060F	0000	000260	1080F					
0000	000274	1090F	0001	001714	110L	0000	000306	1100F	0000	000316	1110F	0000	000340	1120F					
0000	000352	1125F	0000	000355	1130F	0000	000372	1140F	0000	000410	1160F	0000	000432	1170F					
0000	000452	1180F	0000	000471	1190F	0001	000154	12L	0001	000276	120L	0001	000217	130L					
0001	002232	140L	0001	000004	146G	0001	002314	150L	0001	000325	20L	0001	000406	22L					
0001	000466	30L	0001	000547	32L	0001	000627	40L	0001	000702	50L	0001	000775	52L					
0001	001064	60L	0001	001224	70L	0001	001233	80L	0001	001362	90L	0001	001406	91L					
0001	001415	92L	0001	001421	93L	0001	001425	94L	0000	I	000000	A	0004	R	000000	AREA			
0004	R	000074	AREA1	0004	R	000170	AREA1	0004	R	000132	AREA0	0003	R	000066	AREAT	0003	R	000121	AKINJ
0003	R	000625	ATD	0003	R	000613	ATI	0003	R	0006157	CDC	0004	R	0005060	CF	0004	R	0006423	CGGTC
0004	R	0006436	CGTANK	0004	R	0006431	CLTANK	0004	R	0005014	CONCT	0003	R	0005714	CP	0004	R	0006443	CPJU
0004	R	0005006	CSTAR	0003	R	0006102	CV	0004	R	0006355	CVEL	0004	R	000036	DELXL	0004	R	000226	DIALI
0003	R	0006675	DIAT	0004	R	0006277	DMVENT	0003	R	0006550	DQIN	0004	R	0006360	ETAT	0004	R	0006370	F6PC
0004	R	0006376	F8TC	0004	R	0006362	FBAC	0004	R	0005111	FKL	0003	R	0006447	GR	0004	R	0003132	HI
0004	R	0003036	HO	0004	R	0003322	HRAO	0000	I	000160	I	0000	I	000134	ICALLS	0003	I	000132	ICHAM
0004	I	0005110	ICHUN	0003	I	0006323	IEND	0000	I	000164	II	0003	I	000153	IJUNC	0003	I	0003415	IPB
0000	I	000170	IPROP	0003	I	0006637	IPUMI	0003	I	0006637	IPUM0	0003	R	0006143	ISP	0004	R	0005052	ISPT
0000	I	000161	J	0000	I	000162	JJ	0004	I	0003606	JUN	0003	R	0006222	KTHER	0003	R	0006656	KTI
0003	R	0006165	LAMDA	0003	I	0006431	LDMI	0003	I	0006536	LDM0	0003	I	0006517	LDWI	0003	I	0006524	LDMO
0003	R	0004561	MACH	0004	R	0005066	MEX	0000	I	000165	MM	0004	R	0004756	MM	0004	R	0005102	MHC
0000	I	000166	N	0003	I	0006146	NCHAM	0004	I	0002552	NGR	0003	I	000252	NLINJU	0000	I	000163	NN
0003	I	000100	NODEL	0003	I	0005553	NPLINE	0004	R	0002446	NPR	0004	R	0002742	NRE	0003	I	0006013	NSYS
0003	R	0006366	P	0004	R	000264	PB	0004	R	0004764	PC	0003	R	0006151	PCI	0004	R	0004772	PCN
0003	R	0006444	PDELIP	0003	R	0006713	PDR0P	0004	R	0005074	PE	0004	R	000272	PG	0003	R	0004553	PGFBL
0004	R	000620	PGT	0004	R	0005036	PMK	0004	R	0006241	PONC	0004	R	0006350	POWP	0004	R	0006343	POWT
0004	R	0006300	PPI	0004	R	0006305	PPO	0003	I	0006707	PRIN	0003	I	0006601	PROU	0004	R	0006331	PTI
0004	R	0006336	PTO	0003	R	0006651	PWO	0004	R	0006357	R	0004	R	000422	RHOG	0003	R	000546	RHOL

0004 R 006312 RPMT	0003 R 000000 S	0003 I 007065 SYSCOM	0004 R 005044 TC	0004 R 006416 THOC
0003 R 006135 THRT	0000 R 000167 THRUST	0003 R 000611 TIME	0005 R 000012 TKGAM	0005 R 000000 TKMTOT
0005 R 000024 TKMYNT	0005 R 000062 TKP	0005 R 000017 TKRGAS	0005 R 000005 TKRHOL	0005 R 000067 TKT
0005 R 000055 TKTIME	0004 R 006411 TPCG	0004 R 006404 TPCL	0003 R 006574 TTANK	0003 R 001132 TTEMP
0004 R 006317 TTI	0004 R 006324 TTO	0003 R 002242 TTTEMP	0004 R 003226 TALL	0004 R 006356 U
0004 R 003416 UAO	0003 I 006757 VAD	0003 I 006733 VAI	0004 R 003512 VEL	0003 R 000253 VISC
0003 R 003423 WDOTG	0005 R 000031 WGASI	0005 R 000036 WGASO	0004 R 006265 WJ	0005 R 000043 WLIQI
0005 R 000050 WLIQO	0004 R 004750 WNOZ	0004 R 006253 WQ	0003 R 006442 WOL	0003 R 006670 WP
0004 R 006361 WT	0004 R 006246 WTGC	0003 R 000041 WTHCON	0003 R 007003 XK	0003 R 000413 XLENGL

```

00100 10 C
00101 20 SUBROUTINE OUTPRC
00101 30 C
00103 40 REAL MACH,NPR,NRE,KTHER,ISP,MR,MWC,MEX,LAMDA,KTI
00103 50 , ISPT
00103 60 C
00104 70 INTEGER SYSCOM,A,PRIN,PROU,VAI,VAD
00104 80 C
00105 90 DIMENSION ICALLS(20), A(92)
00105 100 C
00105 110 DIMENSION NODEL(20),VISC(30),IEND(6),XLENGL(30),IPB(6)
00106 120 , WDOTG(30,20),PGPBL(6),MACH(30,20),CP(20),SYSCOM(2,150)
00106 130 , KTHER(30),WTHCON(30),PDROP(6),ISP(6),THRT(6),CV(6,2)
00106 140 , ARINJ(6,2),AREAT(6),CDC(6),LAMDA(6),LDM(5),LDMQ(5)
00106 150 , LDM(5),LDWO(5),P(5),TTANK(5),WOL(5),RHOL(3),DWIN(5)
00106 160 , PDELP(5),GR(5),ATI(5),ATD(5),DIAT(5),XK(20)
00106 170 , KTI(5),IJUNC(10,6),ICHAM(6,2),NPLINE(30),IPUMI(5)
00106 180 , IPUMQ(5),PRIN(10),PROU(10),VAI(20),VAD(20)
00106 190 , TTEMP(30,20),TTTEMP(30,20),WLIQU(10),PWO(5),WP(5)
00106 200 , PCI(6)
00106 210 C
00107 220 COMMON /INDATA/ S(5000)
00107 230 C
00110 240 COMMON /COM/AREA(30),DELXL(30),AREAI(30),AREAO(30),AREAK(30)
00110 250 , DIALI(30),PB(6),PG(30,20),RHOG(30,20),NGR(30,2)
00110 260 , NPR(30,2),NRE(30,2),HO(30,2),HI(30,2),TWALL(30,2)
00110 270 , HRAO(30,2),UAO(30,2),VEL(30,2),JUN(10),PGT(30,20)
00110 280 , WNOZ(6),MR(6),PC(6),PCN(6,2),CSTAR(6),CONCT(3,6)
00110 290 , PMR(6),TC(6),ISPT(6),CF(6),MEX(6),PE(6),MWC(6),ICMON
00110 300 , FRL(30,20),PORC(5),WTGC(5),WQ(10),WJ(10),DMVENT,PPI(5)
00110 310 , PPO(5),RPMT(5),TTI(5),TTO(5),PTI(5),PTO(5),POWT(5)
00110 320 , POWP(5),CVEL,U,R,ETAT,WT,FBWC(6),FBPC(6)
00110 330 , FBTC(6),TPCL(5),TPCG(5),THOC(5),CGGTC(6),CLTANK(5)
00110 340 , CGTANK(5),CPJU(5,10)
00110 350 C
00111 360 COMMON /TKOUT/ TKMTOT(5),TKRHOL(5),TKGAM(5),TKRGAS(5),TKMYNT(5),
00111 370 , WGASI(5),WGASO(5),WLIQI(5),WLIQO(5),TKTIME(5),TKP(5)
00111 380 , TKT(5)
00112 390 EQUIVALENCE
00112 400 , (S(65),NODEL(1)), (S(172),VISC(1)), (S(212),IEND(1))
00112 410 , (S(268),XLENGL(1)), (S(1806),IPB(1)), (S(1812),WDOTG(1,1))
00112 420 , (S(2412),PGPBL(1)), (S(2418),MACH(1,1)), (S(3021),CP(1))
00112 430 , (S(3638),SYSCOM(1,1)), (S(3084),NSYS), (S(3219),KTHER(1))
00112 440 , (S(3568),VAD(1)), (S(3212),PDROP(1)), (S(3172),ISP(1))
00112 450 , (S(3166),THRT(1)), (S(3154),ARINJ(1,1)), (S(3139),CV(1,1))

```

```

00112 46*      *,(S(3127),AD(1))      ,(S(3184),CDC(1))      ,(S(3190),LAMD(1))
00112 47*      *,(S(3354),LD(1))      ,(S(3423),LDMO(1))      ,(S(3408),LDN1(1))
00112 48*      *,(S(3413),LDNCT(1))      ,(S(3319),P(1))      ,(S(3453),TTANK(1))
00112 49*      *,(S(3363),WOL(1))      ,(S(359),RHOL(1))      ,(S(3433),DWIN(1))
00112 50*      *,(S(421),POELP(1))      ,(S(3513),WP(1))      ,(S(3368),GR(1))
00112 51*      *,(S(3468),ATI(1))      ,(S(3478),ATD(1))      ,(S(3518),DIAT(1))
00112 52*      *,(S(3588),XK(1))      ,(S(3503),KT1(1))      ,(S(171),NLINJU(1))
00112 53*      *,(S(108),IJUNC(1,1))      ,(S(91),ICHAM(1,1))      ,(S(103),NCHAM)
00112 54*      *,(S(394),TIME)      ,(S(364),NPLINE(1))      ,(S(416),IPUMI(1))
00112 55*      *,(S(3488),IPUMO(1))      ,(S(3528),PRIN(1))      ,(S(3458),PROU(1))
00112 56*      *,(S(3548),VAL(1))      ,(S(603),TTEMP(1,1))      ,(S(1203),TTTEMP(1,1))
00112 57*      *,(S(34),WTHCON(1))      ,(S(426),PHO(1))
00112 58*      *,(S(3178),PCI(1))
00112 59*      C
00113 60*      DATA (ICALLS(I),I=1,20) / 6HPBL      , 6HPIPL
00113 61*      *,      6HADIA8      , 6HISQTH
00113 62*      *,      6HJUNCL      , 6HCHAM
00113 63*      *,      6HCHON      , 6HHEATX
00113 64*      *,      6HTANKD      , 6HTANKC
00113 65*      *,      6HPIPLL      , 6HTURBOP
00113 66*      *,      6HPREG      , 6HVALVG
00113 67*      *,      6HVALVL      , 6H
00113 68*      *,      6H      , 6H
00113 69*      *,      6H      , 6H
00113 70*      C
00115 71*      DATA (A(I),I=1,40)      6HWDOTG      , 6HTTEMP
00115 72*      *,      6HTTEMP      , 6HPGPBL
00115 73*      *,      6HVEL      , 6HMACH
00115 74*      *,      6HDIALI      , 6HVISC
00115 75*      *,      6HCP      , 6H*THCON
00115 76*      *,      6HKTHER      , 6HPG
00115 77*      *,      6HPGT      , 6HRHOG
00115 78*      *,      6HNPR      , 6KNRE
00115 79*      *,      6HRO      , 6HHI
00115 80*      *,      6HFRL      , 6HUAD
00115 81*      *,      6HHRAD      , 6HTNALL
00115 82*      *,      6HXLNGL      , 6HWI
00115 83*      *,      6HWO      , 6HPJI
00115 84*      *,      6HTEM      , 6HWNQZ
00115 85*      *,      6HPDROP      , 6HPCI
00115 86*      *,      6HISP      , 6HTHRT
00115 87*      *,      6HCF      , 6HMR
00115 88*      *,      6HTC      , 6H*RC
00115 89*      *,      6HCSTAR      , 6HAKINJ
00115 90*      *,      6HCV      , 6HMEX
00115 91*      C
00117 92*      DATA (A(I),I=41,80) / 6HAREAI      , 6HAREAT
00117 93*      *,      6HPCN      , 6HPE
00117 94*      *,      6HCDG      , 6HLAMD
00117 95*      *,      6HLDMI      , 6HLDMO
00117 96*      *,      6HLDMI      , 6HLDMO
00117 97*      *,      6HP      , 6HTTANK
00117 98*      *,      6HWOL      , 6HRHOL
00117 99*      *,      6HDMVENT      , 6HDQIN
00117 100*      *,      6HPPI      , 6HPFO
00117 101*      *,      6HPDELPP      , 6HP*U
00117 102*      *,      6HWP      , 6HRPMT
00117 103*      *,      6HGR      , 6HTTI

```

```

00117 104*      *,      6HTTO      , 6HATI
00117 105*      *,      6HATO      , 6HPTI
00117 106*      *,      6HPTO      , 6HCVEL
00117 107*      *,      6HDIAT     , 6HU
00117 108*      *,      6HR        , 6HETAT
00117 109*      *,      6HPOWT     , 6HPOAP
00117 110*      *,      6HWT       , 6HXX
00117 111*      *,      6HKT1      , 6H
00117 112*      C
00121 113*      DATA (A(1),I=81,92) /      6HTIME      , 6HPRESS
00121 114*      *,      6HTEMP      , 6HMTOT
00121 115*      *,      6HRHOL     , 6HRHOG
00121 116*      *,      6HGAM      , 6HVENT
00121 117*      *,      6HWGASI    , 6HWGASO
00121 118*      *,      6HWLIQI    , 6HWLIQO
00121 119*      C
00123 120*      1000 FORMAT(1H0,///7X,30H** PBL - PRESSURE BOUNDARY NO.13,3H **)
00124 121*      1010 FORMAT(//7XA6,1PE14.7,2X,A6,1PE14.7,2X,A6,1PE14.7,
00124 122*      * 2XA6,1PE14.7))
00125 123*      1020 FORMAT(1H0,///7X22H** PIPL - GAS LINE NO.13,35H WITH HEAT TRANSFER
00125 124*      *AND FRICTION **)
00126 125*      1030 FORMAT(// 7X8HNODE NO.13)
00127 126*      1040 FORMAT(1H0,///7X,29H** ADIAB - ADIABATIC LINE NO.13,3H **)
00130 127*      1060 FORMAT(1H0,///7X,30H** ISOTH - ISOTHERMAL LINE NO.13,3H **)
00131 128*      1080 FORMAT(1H0,///7X23H** JUNC1 - JUNCTION NO.13,11H CONNECTING13, 9H L
00131 129*      *INES **)
00132 130*      1090 FORMAT(1H0,///7X36H** CHAM - BIPROPELLANT COMBUSTOR NO.13,3H **)
00133 131*      1100 FORMAT(//7X 8HLINE NO.13,23H CONNECTED TO INLET NO.13)
00134 132*      1110 FORMAT(1H0,///7X38H** CHON - MONOPROPELLANT COMBUSTOR NO.13,22H CON
00134 133*      *NECTED TO LINE NO. 13, 5H WITH13,12H CHAMBERS **)
00135 134*      1120 FORMAT(1H0,///7X39H** TANKD - ACCUMULATOR/STORAGE TANK NO.13,3H **)
00136 135*      1125 FORMAT(// 7X, 4(A6,14,11X) )
00137 136*      1130 FORMAT(1H0,///7X39H** TANKC - ACCUMULATOR/STORAGE TANK NO.13,7H TIM
00137 137*      *E = 1PE14.7,3H **)
00140 138*      1140 FORMAT(1H0,///7X26H** PIPLL - LIQUID LINE NO.13,35H WITH HEAT TRANS
00140 139*      *FER AND FRICTION **)
00141 140*      1160 FORMAT(1H0,///7X39H** TURBOP - TURBOPUMP/GAS GENERATOR NO.13,15H IN
00141 141*      *LET LINE NO.13,16H OUTLET LINE NO.13,3H **)
00142 142*      1170 FORMAT(1H0,///7X32H** PREG - PRESSURE REGULATOR NO.13,15H INLET LIN
00142 143*      *E NO.13,16H OUTLET LINE NO.13,3H **)
00143 144*      1180 FORMAT(1H1,///7X24H** VALVG - GAS VALVE NO.13,15H INLET LINE NO.13,
00143 145*      *16H OUTLET LINE NO.13,3H **)
00144 146*      1190 FORMAT(1H0,///7X27H** VALVL - LIQUID VALVE NO.13,15H INLET LINE NO.
00144 147*      *13,16H OUTLET LINE NO.13,3H **)
00144 148*      C
00145 149*      DO 150 I=1,NSYS
00150 150*      J      = SYSCOM(2,I)
00151 151*      JJ      = 1
00152 152*      NN      = 1
00153 153*      IF (SYSCOM(1,I).NE.1CALLS(1)) GO TO 10
00155 154*      II      = IPB(J)
00156 155*      IF (IEND(J).EQ.2) JJ=NODEL(II)
00160 156*      WRITE(6,1000)J
00163 157*      WRITE(6,1010)A(1),NDOTG(II,JJ),A(2),TTEMP(II,JJ),A(3)
00163 158*      *,      TTEMP(II,JJ),A(4),PGPBL(J),A(6),NACH(II,JJ)
00177 159*      GO TO 150
00200 160*      10 IF (SYSCOM(1,I).NE.1CALLS(2)) GO TO 20
00202 161*      NN      = 1

```

```

00203 162* WRITE(6,1020)
00206 163* WRITE(6,1010)A(7),DIALI(J),A(8),VISC(J),A(9),CP(J),A(10),WTHCON(J)
00206 164* , A(11),KTHERR(J)
00222 165* 12 WRITE(6,1030)JJ
00225 166* WRITE(6,1010)A(5),VEL(J,NN),A(6),MACH(J,JJ),A(2),TTEMP(J,JJ)
00225 167* , A(3),TTTEMP(J,JJ),A(12),PG(J,JJ),A(13),PGT(J,JJ)
00225 168* , A(1),WDOTG(J,JJ),A(14),RHOG(J,MM),A(15),NPR(J,NN)
00225 169* , A(16),NRE(J,NN),A(17),HO(J,NN),A(18),HI(J,NN)
00225 170* , A(19),FRL(J,NN),A(20),UAD(J,NN),A(21),HRAD(J,NN)
00225 171* , A(22),TWALL(J,NN)
00267 172* IF (JJ.NE.1) GO TO 150
00271 173* JJ = NODEL(J)
00272 174* NN = 2
00273 175* MM = JJ - 1
00274 176* GO TO 12
00275 177* 20 IF (SYSCOM(1,1).NE.ICALLS(3)) GO TO 30
00277 178* WRITE(6,1040)J
00302 179* WRITE(6,1010)A(7),DIALI(J),A(23),XLENG(J),A(9),CP(J),A(8),VISC(J)
00302 180* , A(19),FRL(J,1),A(16),NRE(J,1),A(5),VEL(J,1),A(14)
00302 181* , RHOG(J,1)
00324 182* 22 WRITE(6,1030)JJ
00327 183* WRITE(6,1010)A(6),MACH(J,JJ),A(2),TTEMP(J,JJ),A(3),TTTEMP(J,JJ)
00327 184* , A(12),PG(J,JJ),A(13),PGT(J,JJ),A(1),WDOTG(J,JJ)
00345 185* IF (JJ.NE.1) GO TO 150
00347 186* JJ = 2
00350 187* GO TO 22
00351 188* 30 IF (SYSCOM(1,1).NE.ICALLS(4)) GO TO 40
00352 189* WRITE(6,1040)J
00356 190* WRITE(6,1010)A(7),DIALI(J),A(23),XLENG(J),A(9),CP(J),A(8),VISC(J)
00356 191* , A(19),FRL(J,1),A(16),NRE(J,1),A(5),VEL(J,1),A(14)
00356 192* , RHOG(J,1)
00400 193* 32 WRITE(6,1030)JJ
00403 194* WRITE(6,1010)A(6),MACH(J,JJ),A(2),TTEMP(J,JJ),A(3),TTTEMP(J,JJ)
00403 195* , A(12),PG(J,JJ),A(13),PGT(J,JJ),A(1),WDOTG(J,JJ)
00421 196* IF (JJ.NE.1) GO TO 150
00423 197* JJ = 2
00424 198* GO TO 32
00425 199* 40 IF (SYSCOM(1,1).NE.ICALLS(5)) GO TO 50
00427 200* WRITE(6,1040)J,NLINJ(J)
00433 201* II = ABS(IJUNC(1,J))
00434 202* WRITE(6,1010)A(24),W1(J),A(25),W0(J),A(12),PG(11,1),A(2)
00434 203* , TTEMP(11,1)
00446 204* GO TO 150
00447 205* 50 IF (SYSCOM(1,1).NE.ICALLS(6)) GO TO 60
00451 206* WRITE(6,1090)J
00454 207* WRITE(6,1010)A(28),W02(J),A(29),PDROP(J),A(30),PCI(J),A(31)
00454 208* , ISP(J),A(32),THRT(J),A(33),CF(J),A(34),MR(J),A(35)
00454 209* , TC(J),A(36),MWC(J),A(37),CSTAR(J)
00502 210* N = 1
00503 211* 52 WRITE(6,1100)ICHAM(J,N),N
00507 212* II = ICHAM(J,N)
00510 213* JJ = NODEL(11)
00511 214* WRITE(6,1010)A(38),ARINJ(J,N),A(39),CV(J,N),A(3),TTTEMP(11,JJ)
00511 215* , A(13),PGT(11,JJ),A(1),WDOTG(11,JJ)
00525 216* IF (N.EQ.2) GO TO 150
00527 217* N = 2
00530 218* GO TO 52
00531 219* 60 IF (SYSCOM(1,1).NE.ICALLS(7)) GO TO 70

```

```

00533 220*      II = ICHAM(J,1)
00534 221*      WRITE(6,1110)J,II,NCHAM
00541 222*      JJ = NODEL(11)
00542 223*      THRUST = ISPT(J)*WNOZ(J)
00543 224*      WRITE(6,1010)A(40),MEX(J),A(41),AREAI(J),A(42),AREAT(J),A(38)
00543 225*      *, ARINJ(J,1),A(39),CV(J,1),A(3),TTTEMP(11,JJ),A(43)
00543 226*      *, PCN(J,1),A(13),PGT(11,JJ),A(1),WDOTG(11,JJ),A(44)
00543 227*      *, PE(J),A(45),CDC(J),A(46),LAMDA(J),A(32),THRUST
00543 228*      *, A(28),WNOZ(J),A(31),ISPT(J)
00603 229*      GO TO 150
00604 230*      70 IF (SYSCOM(1,1).NE.ICALLS(8)) GO TO 80
00606 231*      CALL WRITE
00607 232*      GO TO 150
00610 233*      80 IF (SYSCOM(1,1).NE.ICALLS(9)) GO TO 90
00612 234*      WRITE(6,1120)J
00615 235*      WRITE(6,1125)A(47),LDMI(J),A(48),LDMO(J),A(49),LDWI(J),A(50)
00615 236*      *, LDWO(J)
00627 237*      WRITE(6,1010)A(81),TKTIME(J),A(82),TKP(J),A(83),TKT(J),
00627 238*      *, A(84),TKMTOT(J),A(85),TKRHOL(J),A(86),TKRGAS(J),A(87),TKGAM(J),
00627 239*      *, A(88),TKMYNT(J),A(89),HGASI(J),A(90),HGASO(J),A(91),WLIQI(J),
00627 240*      *, A(92),WLIQO(J)
00661 241*      GO TO 150
00662 242*      90 IF (SYSCOM(1,1).NE.ICALLS(10)) GO TO 100
00664 243*      WRITE(6,1130)J,TIME
00670 244*      IF (LDMI(J)).91,
00673 245*      II = LDMI(J)
00674 246*      JJ = NODEL(11)
00675 247*      91 IF (LDWI(J)).92,
00700 248*      II = LDWI(J)
00701 249*      JJ = NODEL(11)
00702 250*      92 IF (LDMO(J)).93,
00705 251*      II = LDMO(J)
00706 252*      93 IF (LDWO(J)).94,
00711 253*      II = LDWO(J)
00712 254*      94 IPROP = NPLINE(11)
00713 255*      WRITE(6,1010)A(51),P(J),A(52),TTANK(J),A(53),WOL(J),A(54)
00713 256*      *, RHOL(IPROP),A(2),TTTEMP(11,JJ),A(1),WDOTG(11,JJ)
00713 257*      *, A(55),DMVENT,A(56),DQIN(J)
00735 258*      GO TO 150
00736 259*      100 IF (SYSCOM(1,1).NE.ICALLS(11)) GO TO 110
00740 260*      WRITE(6,1140)J
00743 261*      WRITE(6,1010)A(7),DIALI(J),A(8),VISC(J),A(9),CP(J),A(10),WTHCON(J)
00743 262*      *, A(11),KTHET(J)
00757 263*      102 WRITE(6,1030)JJ
00762 264*      WRITE(6,1010)A(5),VEL(J,NN),A(6),MACH(J,JJ),A(2),TTTEMP(J,JJ)
00762 265*      *, A(3),TTTEMP(J,JJ),A(12),PG(J,JJ),A(13),PGT(J,JJ)
00762 266*      *, A(1),WDOTG(J,JJ),A(14),RHOG(J,JJ),A(15),NPR(J,NN)
00762 267*      *, A(16),NRE(J,NN),A(17),MO(J,NN),A(18),HI(J,NN)
00762 268*      *, A(19),FRL(J,NN),A(20),UAO(J,NN),A(21),HRAD(J,NN)
00762 269*      *, A(22),TWALL(J,NN)
01024 270*      IF (JJ.NE.1) GO TO 150
01026 271*      JJ = NODEL(J)
01027 272*      NN = 2
01030 273*      GO TO 102
01031 274*      110 IF (SYSCOM(1,1).NE.ICALLS(12)) GO TO 120
01033 275*      WRITE(6,1160)J,IPUMI(J),IPUMO(J)
01040 276*      WRITE(6,1010)A(57),PP(J),A(58),PPO(J),A(59),PDEL(J),A(60),PHO(J)
01040 277*      *, A(61),AP(J),A(62),RPMT(J),A(63),GR(J),A(35),TC(J)

```

```

01040 278* 0, A(64),TTI(J),A(65),TTO(J),A(66),ATI(J),A(67),ATD(J)
01040 279* 0, A(68),PTI(J),A(69),PTO(J),A(70),CVEL,A(71),DIAT(J)
01040 280* 0, A(72),U,A(73),R,A(74),ETA,T,A(75),PONT(J),A(76)
01040 281* 0, POWP(J),A(77),WT,A(79),KTI(J)
01120 282* GU TO 150
01121 283* 120 IF (SYSCOM(1,1),NE,ICALLS(13)) GO TO 130
01123 284* WRITE(6,1170)J,PRIN(J),PROU(J)
01130 285* 11 = PROU(J)
01131 286* WRITE(6,1010)A(12),PG(11,1),A(1),WDOTG(11,1),A(14),RHOG(11,1),A(6)
01131 287* 0, MACH(11,1)
01143 288* GO TO 150
01144 289* 130 IF (SYSCOM(1,1),NE,ICALLS(14)) GO TO 140
01146 290* WRITE(6,1180)J,VAI(J),VAD(J)
01153 291* 11 = VAD(J)
01154 292* JJ = NODEL(11)
01155 293* WRITE(6,1010)A(1),WDOTG(11,1),A(12),PG(11,JJ),A(78),XK(J),A(14)
01155 294* 0, RHOG(11,1),A(6),MACH(11,1)
01171 295* GO TO 150
01172 296* 140 IF (SYSCOM(1,1),NE,ICALLS(15)) GO TO 150
01174 297* WRITE(6,1190)J,VAI(J),VAD(J)
01201 298* 11 = VAD(J)
01202 299* JJ = NODEL(11)
01203 300* WRITE(6,1010)A(1),WDOTG(11,1),A(12),PG(11,JJ),A(78),XK(J),A(14)
01203 301* 0, RHOG(11,1),A(6),MACH(11,1)
01217 302* 150 CONTINUE
01217 303* C
01221 304* RETURN
01222 305* END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

OUTPRC CODE SYMBOLIC
OUTPRC RELOCATABLE

31 AUG 71	09:25:16	0	02132674	14	305	{DELETED}
31 AUG 71	09:25:16	1	02143152	36	1	{DELETED}
		0	02143216	14	166	

@ HDG @ FOR, 0 OXYGEN,OXYGEN

3.2.41 OXYGEN

8 FOR, O OXYGEN,OXYGEN
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION HAS DONE ON 31 AUG 71 AT 09:27:54

31 AUG 71

9:27:54.683

SUBROUTINE OXYGEN ENTRY POINT 000100

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000135
0000 *DATA 000446
0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 INTER2
0004 EXP
0005 NERR15

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000 R 000013 AK	0000 R 000000 AP	0000 R 000003 AT	0000 R 000057 BMU	0000 R 000044 BP
0000 R 000047 BT	0000 R 000137 CCCC	0000 R 000107 CCP	0000 R 000114 CCT	0000 R 000276 DP
0000 R 000321 DSV	0000 R 000303 DT	0000 I 000043 IS	0000 R 000427 PI	

```

00101 1* SUBROUTINE OXYGEN (P,T,SV,MU,K,CP,PR)
00101 2* CC
00101 3* CC THIS SUBROUTINE COMPUTES SUPER CRITICAL OXYGEN PROPERTIES
00101 4* CC IN THE RANGE OF 160 R. TO 540 R. AND 1000 PSIA TO 2000 PSIA
00101 5* CC P = PRESSURE (PSIA), INPUT
00101 6* CC T = TEMPERATURE (DEG R), INPUT
00101 7* CC SV= SPECIFIC VOLUME (IN*3/POUND), COMPUTED
00101 8* CC MU= VISCOSITY (POUNDS/IN-SEC), COMPUTED
00101 9* CC K = CONDUCTIVITY (BTU/IN-SEC-DEG R), COMPUTED
00101 10* CC CP= SPECIFIC HEAT CONSTANT PRESSURE (BTU/POUND-DEGR)
00101 11* CC PR= PRANDTL NUMBER (CP*MU/K), COMPUTED
00101 12* CC
00101 13* CC
00103 13* REAL MU,K
00103 14* CC CONDUCTIVITY DATA (P,T VS. LOG (K*10**7))
00104 15* DIMENSION AP( 3),AT( 8),AK( 8, 3)
00105 16* DATA AP/1000.0,1500.0,2000.0/
00107 17* DATA AT/180.0,260.0,280.0,300.0,320.0,400.0,480.0,600.0/
00111 18* DATA AK/2.90,2.34,2.07,1.641,1.322,1.215,1.297,1.477,
00111 19* 1 2.90,2.44,2.28,2.050,1.770,1.411,1.411,1.526,
00111 20* 2 2.90,2.48,2.33,2.180,2.010,1.609,1.552,1.575/
00111 21* CC
00111 22* CC VISCOSITY DATA (P,T VS. LOG (MU*10**6))
00113 23* DIMENSION BP( 3),BT( 8),BMU( 8, 3)
00114 24* DATA BP/1000.0,1500.0,2000.0/
00116 25* DATA BT/180.0,260.0,280.0,300.0,320.0,400.0,480.0,600.0/
00120 26* DATA BMU/2.70,1.359,0.9295,0.1613,0.00912,0.0653,0.1378,0.2920,

```



```

00120 27* 1 1.47,1.171,0.7538,0.4447,0.1620,0.2084,0.3353,
00120 28* 2 2.71,1.56,1.297,1.0086,0.7459,0.2920,0.2770,0.3790/
00120 29* CC
00120 30* CC SPECIFIC HEAT DATA
00122 31* DIMENSION CCP(5),CCT(19),CCCP(19,5)
00123 32* DATA CCP/955.24,1175.68,1469.60,1763.52,2057.44/
00125 33* DATA CCT/160.0,200.0,240.0,250.0,260.0,270.0,280.0,285.0,290.0,
00125 34* 1 295.0,300.0,310.0,320.0,330.0,340.0,350.0,360.0,400.0,540.0/
00127 35* DATA CCCP/0.398,0.413,0.473,0.505,0.555,0.650,0.901,1.283,2.201,
00127 36* 1 1.743,1.075,0.654,0.510,0.434,0.389,0.359,0.338,0.290,0.244,
00127 37* 2 0.396,0.410,0.461,0.484,0.518,0.575,0.678,0.766,0.898,1.058,
00127 38* 3 1.241,1.037,0.724,0.564,0.477,0.423,0.386,0.313,0.250,
00127 39* 4 0.395,0.405,0.448,0.464,0.487,0.520,0.569,0.606,0.652,
00127 40* 5 0.695,0.757,0.853,0.836,0.714,0.598,0.516,0.459,0.345,0.258,
00127 41* 6 0.393,0.402,0.436,0.449,0.466,0.487,0.513,0.537,0.563,
00127 42* 7 0.583,0.612,0.664,0.698,0.689,0.636,0.573,0.514,0.376,0.265,
00127 43* 8 0.392,0.398,0.426,0.437,0.452,0.465,0.479,0.498,0.514,
00127 44* 9 0.527,0.543,0.574,0.600,0.610,0.599,0.571,0.533,0.402,0.272/
00127 45* CC
00127 46* CC SPECIFIC VOLUME DATA
00127 47* CC SV IS A FUNCTION OF TEMP AND INVERSE PRESSURE
00131 48* DIMENSION DPI(5),DT(14),DSV(14,5)
00132 49* DATA DPI/4.8604E-4,5.6705E-4,6.8046E-4,8.5057E-4,10.469E-4/
00132 50* CC CORRESPONDING TO 140,120,100,80, AND 65 ATMOSPHERES
00132 51* CC NOTE 14.696 PSIA = 1 ATMOSPHERE
00134 52* DATA DT/160.0,200.0,240.0,260.0,280.0,290.0,300.0,310.0,320.0,
00134 53* 1 DATA DSV/340.0,370.0,400.0,470.0,540.0/
00136 54* 23.55,25.76,28.86,31.00,33.87,35.72,37.98,40.78,44.23,
00136 55* 1 53.29,69.62,85.31,116.69,143.87,
00136 56* 2 23.62,25.92,29.17,31.52,34.87,37.11,40.07,44.01,49.18,
00136 57* 3 62.67,83.69,101.92,137.48,168.32,
00136 58* 4 23.70,26.06,29.51,32.14,36.13,39.21,43.70,50.54,59.98,
00136 59* 5 80.46,105.74,126.52,167.24,202.94,
00136 60* 6 23.78,24.21,29.91,32.92,36.15,43.38,53.97,71.71,87.99,
00136 61* 7 112.75,141.06,164.78,212.56,255.35,
00136 62* 8 23.85,26.33,30.26,33.64,40.97,55.85,90.13,111.11,126.87,
00136 63* 9 152.03,182.81,209.69,265.33,316.17/
00136 64* CC
00136 65* CC COMPUTE CONDUCTIVITY, AK(T,P)
00140 66* CALL INTER2 (T,AT,P,AP,K,AK,8,3)
00141 67* K=EXP(K)*1.0E-7
00141 68* CC COMPUTE VISCOSITY, BMU(T,P)
00142 69* CALL INTER2 (T,HT,P,BP,MU,BMU,8,3)
00143 70* MU=EXP(MU)*1.0E-6
00143 71* CC
00143 72* CC COMPUTE SPECIFIC HEAT, CCCP(T,P)
00144 73* CALL INTER2 (T,CCT,P,CCP,CP,CCCP,19,5)
00144 74* CC
00144 75* CC
00144 76* CC COMPUTE SPECIFIC VOLUME, DSV(T,PI)
00145 77* PI=1.0/P
00144 78* CALL INTER2 (T,DT,PI,OPI,SV,DSV,14,5)
00146 79* CC
00146 80* CC COMPUTE PRANDTL NUMBER
00147 81* PR=CP*MU/K
00150 82* RETURN
00151 83* END

```

```

      @      FOR,•  OXYGEN,OXYGEN

      END OF UNIVAC 1108 FORTRAN V COMPILATION.
      OXYGEN      SYMBOLIC
      OXYGEN CODE  RELOCATABLE

      @ HDG      @      FOR,•  PACK,PACK

```

DATE 310871 PAGE 220

D •DIAGNOSTIC• MESSAGE(S)

30 APR 71	11:19:53	0	01512632	14	83	(DELETED)
30 APR 71	11:19:53	1	01515044	24	1	(DELETED)
		0	01515074	14	36	

FOR, * PACK, PACK
 UNIVAC 1108 FORTRAN V LEVEL 220 0010 F5010H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:56

31 AUG 71

9:27:56.142

SUBROUTINE PACK ENTRY POINT: 000140

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000162
 0000 *DATA 000045
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000027	120G	0001	000047	131G	0001	000064	137G	0001	000103	150G	0001	000015	3L					
0001	000052	4L	0001	000121	999L	0000	R	000014	ACHAR	0000	R	000013	BSIN	0000	I	000010	I		
0000	I	000001	10CTH	0000	I	000002	10CT31	0000	I	000013	ISIN	0000	I	000012	IWORD	0000	I	000011	J
0000	I	000005	K	0000	I	000004	KWORD	0000	I	000007	K1	0000	I	000006	K2	0000	I	000000	NBLNK1
0000	I	000003	NBLNK2	0000	I	000014	NCHAR	0000	R	000012	WORD								

162

```

00101 10 SUBROUTINE PACK(NCARD, LWORD, N)
00101 20 C.....
00101 30 C.....SUBROUTINE PACK TAKES N WORDS (SINGLE CHARACTER PER WORD) OF
00101 40 C.....NCARD AND PACKS THE ARRAY NCARD INTO LWORD (SIX CHARACTERS PER
00101 50 C.....WORD). 4/1/68
00101 60 C.....
00103 70 DIMENSION
00103 80 * NCARD(1) ,LWORD(1)
00103 90 * ,NCHAR(6)
00103 100 C.....
00104 110 EQUIVALENCE
00104 120 * (IWORD ,WORD) ,(BSIN ,ISIN)
00104 130 * ,(ACHAR ,NCHAR(1))
00104 140 C.....
00105 150 DATA
00105 160 * NBLNK1 / 1H /, 10CTH / 04000000000000 /
00105 170 * , 10CT31 / 00000000000037 /
00105 180 C.....
00111 190 NBLNK2 = FLD(0,6,NBLNK1)
00112 200 IF(N.GT.0) GO TO 3
00114 210 LWORD(1) = NBLNK1
00115 220 GO TO 999
00115 230 C.....
00115 240 C.....KWORD IS THE NUMBER OF IWORD WORDS NEEDED TO PACK N CHARACTERS.
00116 250 3 KWORD = (N+5)/6
00116 260 C.....

```

```

00117 27*      DO 10 K=1,KWORD
00122 28*      IWORD = 0
00122 29*      C*****
00122 30*      C*****FIGURE OUT THE RANGE IN NCARD
00123 31*      K2 = 6*K
00124 32*      K1 = K2-5
00125 33*      IF(K2.LE.N) GO TO 6
00125 34*      C*****
00125 35*      C*****SETUP TO FILL LAST WORD WITH BLANKS
00127 36*      K2 = N
00130 37*      DO 5 I=1,6
00133 38*      5 NCHAR(I) = NBLNK2
00133 39*      C*****
00133 40*      C*****SHIFT TO END OF WORD
00135 41*      6 J = 0
00136 42*      DO 7 I=K1,K2
00141 43*      J = J+1
00142 44*      NCHAR(J) = FLD(0,6,NCARD(I))
00143 45*      7 CONTINUE
00143 46*      C*****
00145 47*      BSIN = AND(NCARD(K1),IOCTM)
00146 48*      ACHAR = AND(NCHAR(I),IOCT31)
00146 49*      C*****
00146 50*      C*****PACK SIX CHARACTERS
00147 51*      DO 35 J=1,6
00152 52*      IWORD = IWORD*64 + NCHAR(J)
00153 53*      35 CONTINUE
00153 54*      C*****
00155 55*      WORD = OR(IWORD,ISIN)
00156 56*      LWORD(K) = IWORD
00156 57*      C*****
00157 58*      10 CONTINUE
00161 59*      N = KWORD
00162 60*      999 RETURN
00163 61*      END

```

163

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

PACK	CODE	SYMBOLIC	RELOCATABLE	30 APR 71	11:19:55	0	01516064	14	61	{DELETED}
PACK				30 APR 71	11:19:55	1	01517612	24	1	{DELETED}
						0	01517642	14	13	

@ HDG @ FOR,* PBL,PBL

FOR, PBL,PBL
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:57

31 AUG 71

9:27:57.451

SUBROUTINE PBL ENTRY POINT 000451

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000463
0000	*DATA	000077
0002	*BLANK	000000
0003	INDATA	011610
0004	CONS	000003
0005	COM	006525

EXTERNAL REFERENCES (BLOCK, NAME)

0006	OPTCP
0007	OPTCV
0010	HPTCP
0011	HPTCV
0012	NERR25
0013	SGRT
0014	NIDUS
0015	N1025
0016	N1015
0017	NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000034	IL	0001	000143	141G	0001	000047	2L	0000	000015	30F	0001	000265	40L
0001	000061	5L	0001	000277	50L	0001	000327	60L	0000	000027	70F	0001	000432	80L
0000	R 000006	A	0005	R 000000	AREA	0005	R 000074	AREA1	0005	R 000170	AREAK	0005	R 000132	AREAO
0000	R 000007	B	0000	R 000010	C	0005	R 005060	CF	0005	R 006423	CGGTC	0005	R 006436	CGTANK
0005	R 006431	CLTANK	0005	R 005014	CONCT	0000	R 000004	CPGAS	0005	R 006443	CPJU	0005	R 005006	CSTAR
0005	R 006355	CVEL	0000	R 000005	CYGAS	0005	R 000036	DELXL	0005	R 000226	DIALI	0003	000510	DIALO
0005	R 006277	DMVENT	0005	R 006360	ETAT	0004	R 000002	F8	0005	R 006370	FBPC	0005	R 006376	F8TC
0005	R 006362	F84C	0000	R 000012	FM2	0000	R 000013	FPM2	0005	R 005111	FRL	0004	R 000001	GC
0005	R 003132	HI	0005	R 003036	HO	0010	R 000000	HPTCP	0011	R 000000	HPTCV	0005	R 003322	HRAD
0005	I 005110	ICHON	0003	I 000323	IEND	0000	I 000000	II	0003	I 003415	IPB	0003	I 000551	IPROP
0005	I 005052	ISPT	0000	I 000011	J	0000	I 000001	JJ	0005	I 003606	JUN	0003	R 003413	KA
0003	R 004561	MACH	0005	I 005066	MEX	0005	I 004756	MR	0005	I 005102	M4C	0000	I 000014	M2P
0005	I 002552	NGR	0003	I 000100	NODEL	0003	I 000553	NPLINE	0005	I 002646	NPR	0005	I 002742	NRE
0006	R 000000	OPTCP	0007	R 000000	OPTCV	0000	R 000002	P	0005	R 000264	PB	0005	R 004764	PC
0005	R 004772	PCN	0005	R 005074	PE	0005	R 000272	PG	0003	R 004553	PGPBL	0005	R 003620	PGT
0004	R 000000	PI	0005	R 005036	PMR	0005	R 006241	POWC	0005	R 006350	POWP	0005	R 006343	PORT
0005	R 006300	PPI	0005	R 006305	PPO	0005	R 006331	PTI	0005	R 006336	PTO	0005	R 006357	R
0003	R 005754	RFLAG	0003	R 005711	RGAS	0005	R 001422	RHUG	0005	R 006312	RPMT	0003	R 000000	S
0000	R 000003	T	0005	R 005044	TC	0003	000451	TH	0005	R 006416	THOC	0005	R 006411	TPCG
0005	R 006404	TPCL	0003	I 003412	TT	0003	R 001132	TTEMP	0005	R 006317	TTI	0005	R 006324	TTO
0003	R 002262	TTTEMP	0005	R 003226	TWALL	0005	R 006356	U	0005	R 003416	UAO	0005	R 003512	VEL
0003	R 003423	WDOTG	0005	R 006265	WI	0005	R 004750	WNOZ	0005	R 006253	WO	0005	R 006361	WT
0005	R 006246	WTGC												

```

00101 10 SUBROUTINE PBL(1;
00101 20 C CONSTANT PRESSURE BOUNDARY SUBROUTINE
00103 30 REAL MACH,KA
00104 40 INTEGER TT
00104 50 C
00105 60 DIMENSION NODEL(20),TH(30),DIALO(30),RGAS(2),TTEMP(30,20)
00105 70 , TTTEMP(30,20),IEND(6),WDOTG(30,20),KA(2),PGPBL(6)
00105 80 , MACH(30,20),IPB(6),NPLINE(30)
00105 90 C
00106 100 COMMON /INDATA/5(5000)
00107 110 COMMON /CONS/FI,GC,FB
00107 120 C
00110 130 COMMON /COM/AREA(30),DELXL(30),AREAL(30),AREAO(30),AREAK(30)
00110 140 , DIALI(30),PB(6),PG(30,20),RHOG(30,20),NGR(30,2)
00110 150 , NPR(30,2),NRE(30,2),HO(30,2),HI(30,2),TWALL(30,2)
00110 160 , HRAO(30,2),UAO(30,2),VEL(30,2),JUN(10),PGT(30,20)
00110 170 , MNQZ(6),MR(6),PC(6),PCN(6,2),CSTAR(6),CONCT(3,6)
00110 180 , PMR(6),TC(6),ISPT(6),CF(6),MEX(6),PE(6),MAC(6),ICMON
00110 190 , FRL(30,20),POK(5),WTGC(5),WO(10),WI(10),DMVENT,PPI(5)
00110 200 , PPO(5),RPMT(5),TTI(5),TTO(5),PTI(5),PTO(5),PQWT(5)
00110 210 , POWP(5),CYEL,U,R,ETAT,WT,FBWC(6),FBPC(6)
00110 220 , FBTC(6),TPCL(5),TPCG(5),THOC(5),CGGTC(6),CLTANK(5)
00110 230 , CGTANK(5),CPJU(5,10)
00110 240 C
00111 250 EQUIVALENCE
00111 260 , (S(65),NODEL(1)),(S(212),IEND(1)),(S(298),TH(1))
00111 270 , (S(329),DIALO(1)),(S(362),IPROP), (S(364),NPLINE(1))
00111 280 , (S(3018),RGAS(1)),(S(603),TTEMP(1,1)),(S(1203),TTTEMP(1,1))
00111 290 , (S(1812),WDOTG(1,1)),(S(1804),KA(1)), (S(2412),PGPBL(1))
00111 300 , (S(2418),MACH(1,1)),(S(1806),IPB(1)), (S(1803),TT)
00111 310 , (S(3053),RFLAG)
00111 320 C
00112 330 II = IPB(1)
00113 340 IF (IEND(1)).EQ.2) GO TO 40
00115 350 JJ = 1
00116 360 IPROP = NPLINE(II)
00117 370 P = PGPBL(1)
00120 380 T = TTEMP(II,JJ)
00121 390 GO TO (1,2), IPROP
00121 400 C OXYGEN
00122 410 1 CPGAS = OPTCP(P,T)
00123 420 CVGAS = OPTCV(P,T)
00124 430 GO TO 5
00125 440 2 CPGAS = HPTCP(P,T)
00126 450 CVGAS = HPTCV(P,T)
00127 460 5 CONTINUE
00130 470 KA(IPROP) = CPGAS / CVGAS
00131 480 RGAS(IPROP) = ( CPGAS - CVGAS ) * 778.156
00132 490 IF (TI.LT.1) GO TO 50
00132 500 C
00132 510 C FLOW VERSUS TOTAL TEMPERATURE
00132 520 C
00134 530 A = KA(IPROP) - 1.0
00135 540 B = SQRT(KA(IPROP)*GC/(RGAS(IPROP)*TTTEMP(1,JJ)))*PGPBL(1)

```

```

00136 550 C      1.0*WDOTG(I1,JJ)/(PI*DIAL1(I1)**2)
00136 560 C
00137 570 MACH(I1,JJ) = 1.0E-1
00137 580 C
00140 590 DO 20 J=1,10
00143 600 FM2 = C + B*MACH(I1,JJ)*SQRT(1.0+A*.5*MACH(I1,JJ)**2)
00144 610 FM2 = C + B*MACH(I1,JJ)**2 * SQRT(1.0+A*.5*MACH(I1,JJ)**2)
00145 620 FPM2 = B * SQRT(2.0/(2.0+A*MACH(I1,JJ)**2)) *
00145 630 (1.0 + A*MACH(I1,JJ)**2)
00146 640 M2P = MACH(I1,JJ) - FM2/FPM2
00147 650 IF (ABS(M2P-MACH(I1,JJ)).LE.1.0E-8.OR.ABS(FM2).LE.1.0E-8) GO TO 60
00151 660 MACH(I1,JJ) = M2P
00152 670 20 CONTINUE
00154 680 WRITE (6,30)
00156 690 30 FORMAT(/,4X46HPBL=NO CONVERGENCE IN NEWTON-RAPHSON ITERATION)
00157 700 GO TO 60
00157 710 C
00160 720 40 CONTINUE
00161 730 JJ = MODEL(I1)
00161 740 C
00161 750 C PRESSURE BOUNDRY CONSTRAINT EQUATION
00161 760 C
00162 770 PB(I) = 1. - PG(I1,JJ) / PGPBL(I)
00163 780 GO TO 60
00163 790 C
00164 800 50 MACH(I1,JJ) = WDOTG(I1,JJ)/(DIAL1(I1)**2*PGPBL(I)) *
00164 810 SQRT(RGAS(IPROP)*TTEMP(I1,JJ)/(6.1685029E+1*GC*KA
00164 820 (IPROP)))
00164 830 C
00165 840 60 PG(I1,JJ) = PGPBL(I)
00166 850 IF (RFLAG).80,
00171 860 WRITE(6,70) I1,JJ,IPROP,TT
00171 870 1, WDOTG(I1,JJ),PI,DIAL1(I1),KA(IPROP)
00171 880 2, GC, RGAS(IPROP), TTEMP(I1,JJ), MACH(I1,JJ)
00171 890 3, TTEMP(I1,JJ), PGPBL(I), PB(I)
00171 900 4, PG(I1,JJ), A, B, C
00171 910 5, FM2, FPM2, P, T
00171 920 6, CPGAS, CVGAS
00224 930 70 FORMAT (1H0//,25X11HPBL=ROUTINE,5X,4I7,/,3(1P8E15.7/))
00225 940 80 RETURN
00226 950 END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION, O *DIAGNOSTIC* MESSAGE(S)

PBL	CODE	SYMBOLIC RELOCATABLE	31 AUG 71	09:25:18	0	02147642	14	95 (DELETED)
PBL			31 AUG 71	09:25:18	1	02152324	36	1 (DELETED)
					0	02152370	14	37

@ HnG 6 FOR, PERFOR,PERFOR

3.2.44 PERFOR

@ FOR,* PERFOR,PERFOR
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:27:59

31 AUG 71

9:27:59.497

SUBROUTINE PERFOR ENTRY POINT 000401

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000476
0000	*DATA	000372
0002	*BLANK	000000
0003	INDATA	011610
0004	HEAT	001074

EXTERNAL REFERENCES (BLOCK, NAME)

0005	CHOICE
0006	WRITE
0007	NWDUS
0010	N1025
0011	N1015
0012	NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000002	124G	0001	000017	15L	0001	000130	170G	0001	000033	20L	0001	000037	30L
0001	000223	40L	0001	000361	50L	0000	000043	9901F	0000	000052	9902F	0000	000134	9903F
0000	000317	9904F	0000	000042	9906F	0000	000175	9907F	0000	000241	9908F	0000 R	000015	AAA
0000 R	000023	AAB	0000 R	000024	AAC	0000 R	000025	AAD	0000 R	000021	AFI	0000 R	000026	AFO
0000 R	000016	AHI	0000 R	000017	AHO	0000 R	000020	AHOW	0000 I	000000	ANAM2	0000 I	000004	ANAM3
0004 R	000002	CPI	0004 R	000027	CPO	0004 R	000054	DIST	0000 R	000036	DPI	0000 R	000037	DPO
0000 R	000040	DTI	0000 R	000041	DTO	0004 R	000101	HE	0004 R	000720	HI	0004 R	000772	HO
0004 R	000745	HW	0000 I	000031	I	0000 I	000011	IS	0000 I	000007	JOUT	0000 I	000012	K
0004 R	000126	KI	0004 R	000153	KO	0004 R	000200	KW	0003 R	006304	LENGTH	0004 R	000225	MUI
0004 R	000252	MUO	0000 I	000013	NI	0000 I	000014	N2	0004 R	001071	PHI1	0004 R	001072	PHI2
0004 R	001073	PHI3	0004 R	000277	PI	0000 R	000010	PIE	0000 R	000033	PII	0004 R	000324	PO
0000 R	000034	POI	0004 R	000351	PRI	0004 R	000376	PRO	0004 R	000423	Q	0004 R	001017	QUAL1
0004 R	001044	QUAL0	0004 R	000450	REI	0004 R	000475	REO	0003 R	005754	RFLAG	0003 R	006316	RI
0003 R	006424	RO	0003 R	000000	S	0004 R	000522	SVI	0004 R	000547	SVO	0003 R	006323	THICK
0004 R	000574	TI	0000 R	000032	TII	0004 R	000621	TO	0000 R	000035	TOL	0004 R	000646	THI
0004 R	000673	TWO	0003 I	006311	TYPE	0004	000002	VAR	0000 R	000022	VOLIN	0000 R	000027	VOLOUT
0000 R	000030	VOLVAL	0004 R	000000	WD	0003 R	006342	XI	0003 R	006347	XO			

```

00101 1* SUBROUTINE PERFOR (TIN,PIN,WDI,WDO,TOUT,POUT,LI,LO,LN
00101 2* P02,T02,P12,T12,QT)
00101 3*
00101 4* CC THIS ROUTINE IS USED TO COMPUTE HEAT EXCHANGER PERFORMANCE
00101 5* CC WHEN INLET CONDITIONS ARE KNOWN FOR BOTH COUNTERFLOW AND
00101 6* CC PARALLEL FLOW DESIGNS. THE CONCENTRIC TUBE CONFIGURATION IS
00101 7* CC ASSUMED, WITH THE OUTER FLUID FLOWING IN AN ANNULUS

```



```

00103 8* INTEGER ANAM3
00103 9* C
00104 10* INTEGER TYPE
00104 11* C
00105 12* REAL LENGTH,K1,KC,KW,MUI,MUO
00105 13* C
00106 14* DIMENSION VAR(21,22),ANAM2(4),ANAM3(3)
00106 15* C
00107 16* DIMENSION LENGTH(S),RI(S),RO(S),THICK(S),TYPE(S),XI(S),XO(S)
00107 17* C
00110 18* COMMON /INDATA/S(5000)
00110 19* C
00111 20* COMMON /HEAT/40(2),CPI(21),CPO(21),DIST(21),HE(21),K1(21),K0(21)
00111 21* 1, K*(21),MUI(21),MUO(21),PI(21),PU(21),PRI(21),PRO(21)
00111 22* 2, Q(21),REI(21),REC(21),SVI(21),SVO(21),TI(21),TO(21)
00111 23* 3, THI(21),TKO(21),HI(21),HW(21),HO(21)
00111 24* 4, QUALI(21),QUALO(21)
00111 25* 4, PHI1,PHI2,PHI3
00111 26* C
00112 27* EQUIVALENCE
00112 28* * (S(3279),RI(1)) , (S(3349),RO(1)) , (S(3269),LENGTH(1))
00112 29* * , (S(3274),TYPE(1)) , (S(3284),THICK(1)) , (S(3299),XI(1))
00112 30* * , (S(3304),XO(1))
00112 31* * , (S(3053),RFLAG)
00112 32* C
00113 33* EQUIVALENCE (VAR(1,1),CPI(1))
00113 34* C
00114 35* DATA JOUT /6/ , PIE / 3.1415927 /
00117 36* DATA ANAM2/6HCOUNTE,6HR FLOW,6HPARALL,6HEL FLO/
00121 37* DATA ANAM3/2HH2,2HO2,6HH2+H2O/
00121 38* C
00123 39* DO 60 K = 1,21
00126 40* PI(K) = PIN
00127 41* PO(K) = POUT
00131 42* IF (RFLAG),15,
00134 43* WRITE(JOUT,9906)
00136 44* 9906 FORMAT(1H1)
00137 45* 15 IF (TYPE(LN).EQ.2) GO TO 20
00141 46* N1=1
00142 47* N2=2
00143 48* GO TO 30
00144 49* 20 N1=3
00145 50* N2=4
00146 51* 30 CONTINUE
00147 52* AAA=PIE*2.0*LENGTH(LN)
00150 53* AH1=AAA*RI(LN)
00151 54* AH0=AAA*THICK(LN)+AH1
00152 55* AMO=AAA*RO(LN)
00153 56* AFI=PIE*RI(LN)**2
00154 57* VOLIN=AFI*LENGTH(LN)
00155 58* AAB=PIE* RO(LN)**2
00156 59* AAC=PIE*(RI(LN)+THICK(LN))**2
00157 60* AAD=PIE*(RO(LN)+THICK(LN))**2
00160 61* AFO =AAB-AAC
00161 62* VOLOUT=AFO*LENGTH(LN)
00162 63* VOL*AL=LENGTH(LN)*(AAD-AAB+AAC-AFI)
00163 64*
00163 65* IF (RFLAG),40,

```

```

00166 660 WRITE(JOUT,9901)(ANAM2(I),I=N1,N2)
00174 670 9901 FORMAT(1H1/10X,2A6,23HHEAT EXCHANGER ANALYSIS//)
00175 680
00175 690 WRITE(JOUT,9902) LENGTH(LN),VOLIN ,RI(LN),VOLOUT ,RO(LN),
00175 700 1 VOLWAL ,THICK(LN)
00206 710 9902 FORMAT(10X,25HHEAT EXCHANGER DIMENSIONS//10X, 7HVOLUMES,33X,
00206 720 1 8HLENGTH =F14.3,7H INCHES/10X,13HINNER FLUID =F10.3,5H CUIN,12X,
00206 730 2 14HINNER RADIUS =,F8.3,7H INCHES/10X,13HOUTER FLUID =F10.3,
00206 740 3 5H CUIN,12X,14HOUTER RADIUS =,F8.3,7H INCHES/10X, 9H WALL (IN+,
00206 750 4 6HOUT) =,F8.3,5H CUIN,12X,12HWALL THICK =F10.3,7H INCHES/)
00207 760
00207 770 WRITE(JOUT,9903)ANAM3(LI),WDI,TIN,PIN,
00207 780 1 ANAM3(LO),WDO,TOUT,POUT
00221 790 9903 FORMAT(1H0,9X, 8HENTRANCE,8X,5HFLUID,12X,8HFLOWRATE,7X,
00221 800 1 12HTEMP (DEG R),3X,15HPRESSURE (PSIA)/10X,10HCONDITIONS/10X,
00221 810 2 6HINSIDE,10X,A6,11X,F8.4,7X,F8.2,7X,F8.2/10X,7HOUTSIDE,9X,A6,
00221 820 3 11X,F8.4,7X,F8.2,7X,F8.2//)
00222 830
00222 840 WRITE(JOUT,9907) AHI,AFI,AHO,AFO,AHOW
00231 850 9907 FORMAT(1H0,9X,19HHEAT TRANSFER AREAS,26X,16HFLUID FLOW AREAS/
00231 860 1 10X,10HINNER TUBE,F15.2,5H SQIN,10X,10HINNER FLOW,F15.2,5H SQIN/
00231 870 2 10X,10HOUTER TUBE,F15.2,5H SQIN,10X,10HOUTER FLOW,F15.2,5H SQIN/
00231 880 3 10X,10HOUTER WALL,F15.2,5H SQIN/)
00231 890 CC
00231 900 CC COMPUTE PERFORMANCE
00231 910 CC COUNTER FLOW
00232 920 40 T11 = TIN
00233 930 T12=TIN
00234 940 P11=PIN
00235 950 P12=PIN
00236 960 P02=POUT
00237 970 T02=TOUT
00237 980 CC PARALLEL FLOW
00240 990 P01=POUT
00241 1000 T01=TOUT
00241 1010 CC COMPUTE HEAT TRANSFER
00242 1020 CALL CHOICE (LN,LI,T11,T12,T01,T02 ,P11,P12,P01,P02 ,WDI,WDO,
00242 1030 1 QT,LO,XI(LN),XO(LN))
00243 1040 DPI=P11-P12
00244 1050 DPO=P01-P02
00245 1060 DTI=T11-T12
00246 1070 DTO=T01-T02
00247 1080
00247 1090 IF (RFLAG),50,
00252 1100 WRITE(JOUT,9908) ANAM3(LI),ANAM3(LO),T11,P11,T01,P01,
00252 1110 1 T12,P12,T02,P02,
00252 1120 2 DTI,DPI,DTO,DPO
00272 1130 9908 FORMAT(/ 33X,45HSUMMARY OF CALCULATION RESULTS AT EACH END OF,
00272 1140 1 19H THE HEAT EXCHANGER//27X,14HINSIDE FLUID (,A6,1H),19X,
00272 1150 2 15HOUTSIDE FLUID ( ,A6,1H)//20X,2(4X,12HTEMP (DEG R), 8X,
00272 1160 3 12HPRESS (PSIA),4X)//10X,7HEND ONE,F17.2,3F20.2//10X,
00272 1170 4 7HEND TWO,F17.2,3F20.2//10X,10HDIFFERENCE,F14.2,3F20.2/)
00273 1180
00273 1190 WRITE(JOUT,9904) QT
00276 1200 9904 FORMAT(10X,27HTOTAL HEAT TRANSFER RATE = ,F10.2,10H (BTU/SEC),
00276 1210 1 23H FROM OUTSIDE TO INSIDE//)
00276 1220 CC
00277 1230 CALL WRITE

```

00300 124* 50 RETURN
00301 125* END

END OF UNIVAC 1108 FORTRAN COMPILATION.
PERFOR SYMBOLIC
PERFOR CODE RELOCATABLE

0 *DIAGNOSTIC* MESSAGE(S)

23 JUN 71	21:26:12	0	01712222	14	125	(DELETED)
23 JUN 71	21:26:12	1	01715550	36	1	(DELETED)
		0	01715614	14	54	

HDG 6 FOR, P1PL,P1PL

3.2.45 PIPL

FOR, PIPL,PIPL
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:01

31 AUG 71

9:28: 1.669

SUBROUTINE PIPL ENTRY POINT 001177

PIPLL ENTRY POINT 001204

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	001211
0000	*DATA	000170
0002	*BLANK	000000
0003	INDATA	011610
0004	COM	006525
0005	CONS	000003

EXTERNAL REFERENCES (BLOCK, NAME)

0006	OPTCP
0007	OPTCV
0010	OPTTC
0011	OPTV
0012	HPTCP
0013	HPTCV
0014	HPTTC
0015	HPTV
0016	OPTD
0017	HPTD
0020	FCOMP1
0021	NERR2s
0022	COS
0023	SQRT
0024	NEXP6s
0025	EXP
0026	NWDUS
0027	NIO1s
0030	NIO2s
0031	NERR3s

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000024	1L	0001	000011	10L	0001	000253	11L	0001	000245	12L	0001	000242	145G
0001	000276	15L	0001	000074	2L	0001	000332	20L	0001	000461	202G	0001	000344	30L
0001	000400	35L	0001	000143	5L	0001	000673	50L	0001	000736	60L	0001	000767	70L
0000	000062	80F	0001	001122	85L	0000	R 000057	A	0003	R 000355	ALPHA	0004	R 000000	AREA
0004	R 000074	AREA1	0004	R 000170	AREAK	0004	R 000132	AREAO	0000	R 000060	B	0004	R 005060	CF
0004	R 006423	CGGTC	0004	R 006436	CGTANK	0004	R 006431	CLTANK	0004	R 005014	CONCT	0003	R 005714	CP
0004	R 006443	CPJU	0004	R 005006	CSTAR	0000	R 000000	CV	0004	R 006355	CVEL	0000	R 000061	D
0003	R 006436	OE	0004	R 000036	DELXL	0004	R 000226	DIAL1	0003	R 000510	DIALO	0004	R 006277	DMVENT
0003	R 000003	EMIS	0004	R 006360	ETAT	0005	R 000002	FB	0004	R 006370	FBPC	0004	R 006376	FBTC
0004	R 006362	FBWC	0004	R 005111	FRL	0005	R 000001	GC	0003	R 005752	GEE	0000	R 000054	GF3
0004	R 003132	HI	0003	R 000002	HNPR	0003	R 000001	HNKE	0004	R 003036	HO	0003	R 000000	HQEX

0012	R	000000	HP TCV	0013	R	000000	HP TCV	0017	R	000000	HP TD	0014	R	000000	HP TTC	0015	R	000000	HPTV
0003	R	001050	HR	0003	R	003322	HRAD	0003	I	001012	HRS	0004	I	005068	ICMON	0003	I	000551	IPROP
0004	I	005052	ISPT	0004	I	000050	JJ	0004	I	003606	JUN	0003	R	003000	KA	0003	R	006014	KLT
0003	R	006222	KTHER	0000	I	000046	LL	0003	R	004561	MACH	0004	I	005068	MEX	0004	I	004756	MR
0004	I	005102	MAC	0000	I	000052	N	0004	R	002552	NGR	0000	I	000047	NN	0000	I	000045	NNODEL
0003	I	000100	NODEL	0003	I	000553	NPLINE	0004	R	002646	NPR	0004	R	002742	NRE	0006	R	000000	OPTCP
0007	R	000000	OPTCV	0016	R	000000	OPTD	0010	R	000000	OPTTC	0011	R	000000	OPTV	0004	R	000264	PB
0004	R	004764	PC	0004	R	004772	PCN	0004	R	005074	PE	0004	R	000272	PG	0004	R	003620	PGT
0005	R	000000	PI	0004	R	005036	PMR	0004	R	004241	POWC	0004	R	006350	POWP	0004	R	006343	PQWT
0004	R	006300	PPI	0004	R	006305	PPO	0004	R	006331	PTI	0004	R	006336	PTO	0004	R	006357	R
0000	R	000053	RAO	0003	R	005754	RFLAG	0003	R	005711	RGAS	0000	R	000051	RHO	0004	R	001422	RHOG
0003	R	000546	RHOL	0004	R	006312	RPMT	0003	R	000000	S	0004	R	005044	TC	0003	R	005753	TENV
0004	R	006416	THOC	0004	R	006411	TPCG	0004	R	006404	TPCL	0003	R	001132	TTEMP	0004	R	006317	TTI
0004	R	006324	TTO	0003	R	002262	TTEMP	0004	R	003226	TWALL	0004	R	006356	U	0004	R	003416	UAO
0004	R	003512	VEL	0003	R	000253	VISC	0003	R	006437	WISE	0003	R	003423	WDOTG	0004	R	006265	WJ
0004	R	004750	WNOZ	0004	R	006253	WO	0004	R	006361	WT	0004	R	006246	WTGC	0003	R	000041	WTHCON
0000	R	000036	X	0003	R	006413	XLENGL	0000	R	000055	XX	0000	R	000056	YY				

```

00101 1* SUBROUTINE PIPL (I)
00101 2* C PIPE WITH CONTANT TEMPERATURE EVIRONMENT HEAT TRANSFER INTO LINE
00101 3* C
00103 4* REAL KA,MACH,NGR,NPR,NRE,KTHER
00103 5* * KLT
00103 6* C
00103 7* C
00104 8* INTEGER HRS
00104 9* C
00105 10* DIMENSION EMIS(30),WTHCON(30),NODEL(20),VISC(30),NPLINE(30)
00105 11* *, TTEMP(30,20),TTTEMP(30,20),KA(2),WDOTG(30,20)
00105 12* *, MACH(30,20),RGAS(2),CP(30),DIALO(30)
00105 13* *, HRS(30),HR(30),KLT(30),KTHER(30),CV(30),XLENGL(30)
00105 14* *, ALPHA(30),RHOL(3)
00105 15* C
00106 16* DIMENSION X(7)
00106 17* C
00107 18* COMMON /INDATA/S(5000)
00107 19* C
00110 20* COMMON /COM/AREA(30),DELXL(30),AREAI(30),AREAO(30),AREAK(30)
00110 21* *, DIALI(30),PB(6),PG(30,20),RHOG(30,20),NGR(30,2)
00110 22* *, NPR(30,2),NRE(30,2),HO(30,2),HI(30,2),TWALL(30,2)
00110 23* *, HRAD(30,2),UAO(30,2),VEL(30,2),JUN(10),PGT(30,20)
00110 24* *, WNOZ(6),MR(6),PC(6),PCN(6,2),CSTAR(6),CONCT(3,6)
00110 25* *, PMR(6),TC(6),ISPT(6),CF(6),MEX(6),PE(6),MAC(6),ICMON
00110 26* *, FRL(30,20),POWC(5),WTGC(5),WO(10),WI(10),UMVENT,PPI(5)
00110 27* *, PPO(5),RPMT(5),TTI(5),TTO(5),PTI(5),PTO(5),PQWT(5)
00110 28* *, POWP(5),CVEL,U,R,ETAT,WT,FBWC(6),FBPC(6)
00110 29* *, FBTC(6),TPCL(5),TPCG(5),THOC(5),CGGTC(6),CLTANK(5)
00110 30* *, CGTANK(5),CPJU(5,10)
00110 31* C
00111 32* COMMON /CONS/PI,GC,FB
00111 33* C
00112 34* EQUIVALENCE
00112 35* * (S(2),HNRE), (S(3),HNPR), (S(4),EMIS(1))
00112 36* *,(S(34),WTHCON(1)), (S(65),NODEL(1)), (S(172),VISC(1))
00112 37* *,(S(329),DIALO(1)), (S(362),IPROP), (S(364),NPLINE(1))

```

```

00112 38*      *,(S(603),TTEMP(1,1)),(S(1804),KA(1)),(S(1203),TTTEMP(1,1))
00112 39*      *,(S(1812),WDOTG(1,1)),(S(2418),MACH(1,1)),(S(3018),RGAS(1))
00112 40*      *,(S(3021),CP(1)),(S(3051),GEE),(S(3052),TENV)
00112 41*      *,(S(3219),KTHE(1)),(S(1),HUEX)
00112 42*      *,(S(523),HRS(1)),(S(553),HR(1)),(S(3085),KLT(1))
00112 43*      *,(S(268),XLENG), (S(238),ALPHA), (S(359),RHOL)
00112 44*      *,(S(3053),RFLAG), (S(3359),DE), (S(3360),VISE)
00112 45*      C
00112 46*      C
00113 47*      NNODEL = NODEL(11) - 1
00114 48*      LL = 0
00115 49*      GO TO 10
00116 50*      ENTRY PIPL(11)
00120 51*      LL = 1
00121 52*      NNODEL = 1
00122 53*      10 CONTINUE
00123 54*      IPROP = NPLINE(11)
00124 55*      GO TO (1,2), IPROP
00125 56*      1 CONTINUE
00125 57*      C OXYGEN PROPERTIES
00126 58*      CP(11) = OPTCP(PG(11,1),TTEMP(11,1))
00127 59*      CV(11) = OPTCV(PG(11,1),TTEMP(11,1))
00130 60*      KTHE(11) = OPTTC ( PG(11,1),TTEMP(11,1) )
00131 61*      VISC(11) = OPTV (PG(11,1),TTEMP(11,1) ) * 32.2 * 3600.
00132 62*      2 GO TO 5
00132 63*      2 CONTINUE
00133 64*      C HYDROGEN PROPERTIES
00134 65*      CP(11) = HPTCP(PG(11,1),TTEMP(11,1))
00135 66*      CV(11) = HPTCV(PG(11,1),TTEMP(11,1))
00136 67*      KTHE(11) = HPTTC ( PG(11,1),TTEMP(11,1) )
00137 68*      VISC(11) = HPTV (PG(11,1),TTEMP(11,1) ) * 32.2 * 3600.
00140 69*      5 CONTINUE
00141 70*      RGAS(IPROP) = (CP(11)-CV(11)) * 778.156
00142 71*      KA(IPROP) = CP(11) / CV(11)
00142 72*      C
00142 73*      C LOOP OVER ALL NODES IN LINE
00143 74*      NN = 1
00144 75*      DO 90 JJ=1,NNODEL
00144 76*      C
00144 77*      C COMPUTE FLUID DENSITY
00147 78*      GO TO (11,12), IPROP
00150 79*      11 RHO = OPTD ( PG(11,JJ), TTEMP(11,JJ) )
00151 80*      GO TO 15
00152 81*      12 RHO = HPTD ( PG(11,JJ), TTEMP(11,JJ) )
00153 82*      15 CONTINUE
00153 83*      C
00154 84*      IF (LL) ,20
00154 85*      C VELOCITY IN LINE = FT/SEC
00157 86*      VEL(11,NN) = 576. * WDOTG(11,JJ) / (PI * RHO * DIALI(11)**2 )
00157 87*      C MACH NUMBER IN LINE
00160 88*      MACH(11,JJ) = VEL(11,NN) / SQRT (KA(IPROP) * RGAS(IPROP) * GC *
00160 89*      1 TTEMP(11,JJ) )
00160 90*      C DENSITY OF GAS
00161 91*      RHOG(11,JJ) = RHO
00162 92*      GO TO 30
00163 93*      20 CONTINUE
00163 94*      CC PIPL = LIQUID PIPE LINE SUBROUTINE
00163 95*      CC PIPL

```

```

00164 96* RHOL(IPROP)*RHO
00165 97* VEL(II,1) = 4.04*NDOTG(II,1) / (RHOL(IPROP)*PI*DIALI(II)*2)
00166 98* 30 CONTINUE
00167 99* TTEMP(II,JJ) = TTEMP(II,JJ) + VEL(II,NN)*2/(2.0*GC*FB*CP(II))
00170 100* IF (GEE,LE,0.) GO TO 35
00170 101* C GRASHOF NUMBER
00172 102* NGR(II,NN) = (GEE*(TENV - TTEMP(II,JJ))*DE**2*DIALO(II)*3)/
00172 103* (TENV*VISE**2*1728.)
00173 104* 35 CONTINUE
00173 105* C PRANDTL NUMBER
00174 106* NPR(II,NN) = (CP(II)*VISC(II))/KHER(II)*3600.0
00174 107* C REYNOLDS NUMBER
00175 108* NRE(II,NN) = NDOTG(II,JJ)/(PI*DIALI(II)*VISC(II)*3.0)*144.
00175 109* C KOO FRICTION FACTOR FOR SMOOTH PIPES - PG.383 CHE. HANDBOOK EQ. 24
00176 110* FRL(II,NN) = 1.4E-3 + 1.25E-1 * (NRE(II,NN))** (-0.32)
00176 111* C FILM COEFFICIENT INNER WALL
00177 112* HO(II,NN) = KHER(II)*0.53/DIALO(II)*(NGR(II,NN)*NPR(II,NN))
00177 113* * HOEX*12.0
00177 114* C FILM COEFFICIENT INNER WALL
00200 115* HI(II,NN) = KHER(II)*0.023/DIALI(II)*(NRE(II,NN)*HNRE*
00200 116* * NPR(II,NN)*HNPR)*12.0
00200 117* C ESTIMATE INNER WALL TEMPERATURE
00201 118* DO 40 N=1,2
00201 119* C ESTIMATE WALL TEMP
00204 120* TWALL(II,NN) = ((HO(II,NN)*RAD)*TENV + HI(II,NN)*TTEMP(II,JJ))/
00204 121* ((HO(II,NN)*RAD + HI(II,NN))
00204 122* C RADIATION EQUIVALENT HEAT TRANSFER COEFFICIENT
00205 123* RAD = 0.1714E-8*EMIS(II) * (TENV+TWALL(II,NN)) *
00205 124* (TENV**2 + TWALL(II,NN)**2)
00206 125* 40 CONTINUE
00210 126* HRAD(II,NN) = RAD
00210 127* C OVERALL HEAT TRANSFER COEFFICIENT
00211 128* UAO(II,NN) = 1./((1./((HO(II,NN)+HRAD(II,NN))*AREA0(II)))+(1./((HI(II
00211 129* * NN)*AREAI(II)))+(AREAK(II)/WTHCON(II)))
00211 130* CC PIPL
00212 131* IF (LL.EQ,1) GO TO 50
00212 132* C TOTAL LINE STAGNATION TEMPERATURE AT EACH NODE IN LINE
00214 133* TTEMP(II,JJ+1) = TENV-(TENV-TTEMP(II,JJ))/(EXP(UAO(II,NN)*0.16/
00214 134* 1*(PI*RHO(II,JJ)*DIALI(II)*2*VEL(II,JJ)*CP(II))))
00214 135* C FRICTION FACTOR LINE
00214 136* C STATIC PRESSURE IN LINE
00214 137* C
00215 138* X(1) = MACH(II,JJ)
00216 139* X(2) = TTEMP(II,JJ)
00217 140* X(3) = TTEMP(II,JJ+1)
00220 141* X(4) = FRL(II,NN)
00221 142* X(5) = DELXL(II)
00222 143* X(6) = DIALI(II)
00223 144* X(7) = KA(IPROP)
00223 145* C
00224 146* CALL FCOMP1 (X,MACH(II,JJ+1),GF3)
00224 147* C
00224 148* C MACH NUMBER DIFFERENTIAL EQ
00225 149* PG(II,JJ+1) = (PG(II,JJ)*MACH(II,JJ))/MACH(II,JJ+1)*SQRT((1+(KA(
00225 150* 1(IPROP)-1)*.5*MACH(II,JJ)**2)/(1+(KA(IPROP)-1)*.5*MACH(II,JJ+1)**2
00225 151* 2)*TTEMP(II,JJ+1)/TTEMP(II,JJ))
00225 152* C STATIC TEMPERATURE
00226 153* TTEMP(II,JJ+1) = TTEMP(II,JJ)*TTEMP(II,JJ+1)/TTEMP(II,JJ) *

```

```

00226 154*      *      (1.0 + 0.5*(KA(IPROP)-1.0)*MACH(II,JJ)**2)/
00226 155*      *      (1.0 + 0.5*(KA(IPROP)-1.0)*MACH(II,JJ+1)**2)
00226 156*      C FLOWRATE
00227 157*      WDOTG(II,JJ+1) = WDOTG(II,JJ)
00227 158*      C TOTAL PRESSURE
00230 159*      XX = (1.0 + (KA(IPROP)-1.0)*0.5*MACH(II,JJ)**2) **
00230 160*      *      (KA(IPROP)/(KA(IPROP)-1.0))
00231 161*      YY = (1.0 + (KA(IPROP)-1.0)*0.5*MACH(II,JJ+1)**2) **
00231 162*      *      (KA(IPROP)/(KA(IPROP)-1.0))
00232 163*      PGT(II,JJ) = PG(II,JJ)*XX
00233 164*      PGT(II,JJ+1) = PG(II,JJ+1)*YY
00234 165*      GO TO 70
00234 166*      CC PIPL
00235 167*      50 CONTINUE
00236 168*      CV(II) = CP(II)/KA(IPROP)
00237 169*      A = (PI*DIALI(II)**2)/4.1**2
00240 170*      B = WDOTG(II,1)**2/D/(RHOL(IPROP)**2)*GC*A**2*FB*CV(II)
00241 171*      D = FRL(II,1) * XLENG(II) / DIALI(II)
00242 172*      IF (HRS(II)*EQ.1) GO TO 40
00244 173*      HR(II) = (D + KLT(II))/(2.*GC*A)
00245 174*      WDOTG(II,2) = WDOTG(II,1)
00246 175*      60 CONTINUE
00247 176*      PG(II,2) = PG(II,1)+RHOL(IPROP)*GEE*XLENG(II)*COS(ALPHA(II))/GC *
00247 177*      *      144.*D - HR(II)*WDOTG(II,1)**2/RHOL(IPROP)
00250 178*      TTEMP(II,2) = TTEMP(II,1) + UAO(II,1)*(TENV - TTEMP(II,1))/(WDOTG
00250 179*      *      (II,1)*CV(II)) + D*B
00251 180*      LL = 0
00252 181*      70 CONTINUE
00252 182*      C
00253 183*      IF (RFLAG).85,
00256 184*      WRITE(6,80)II,JJ,NNODEL,IPROP
00256 185*      *,
00256 186*      *      VEL(II,NN),MACH(II,JJ),KA(IPROP),GC
00256 187*      *      ,
00256 188*      *      RGAS(IPROP),TTEMP(II,JJ),TTEMP(II,JJ),PG(II,JJ)
00256 189*      *      ,
00256 190*      *      RHOG(II,JJ),NGR(II,NN),GEE,TENV,DIALO(II)
00256 191*      *      ,
00256 192*      *      VISC(II),NPR(II,NN),CP(II),NRE(II,NN)
00256 193*      *      ,
00256 194*      *      DIALI(II),HO(II,NN),KTHE(II),HII(II,NN)
00256 195*      *      ,
00256 196*      *      TWALL(II,NN),HRAD(II,NN),UAO(II,NN),AREAD(II)
00256 197*      *      ,
00256 198*      *      AREAI(II),AREAK(II),WTHCON(II),RAD
00256 199*      *      ,
00256 200*      *      PI,FRL(II,NN),MACH(II,JJ+1),PG(II,JJ+1)
00256 201*      *      ,
00256 202*      *      TTEMP(II,JJ+1),WDOTG(II,JJ+1)
00257 203*      80 FORMAT(1H0//24X12HP1PL~ROUTINE: 5X4I7,/, 5(1P8E15.7/))
00330 195*      85 NN = 2
00331 196*      90 CONTINUE
00333 197*      RETURN
00334 198*      END

```

END OF UNIVAC 110B FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

PIPL	SYMBOLIC	31 AUG 71	09:25:21	0	02153376	14	198	(DELETED)
PIPL	CODE	RELOCATABLE	31 AUG 71	09:25:21	1	02160722	48	1 (DELETED)
					0	02161002	14	73

@ HDG B FOR, PREG,PREG

S FOR,* PREG,PREG
 UNIVAC 1108 FORTRAN V LEVEL 2 2018 FS018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:05

31 AUG 71

9:28: 5.434

SUBROUTINE PREG ENTRY POINT 000153

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000166
0000	*DATA	000044
0002	*BLANK	000000
0003	CONS	000003
0004	INDATA	011610
0005	COM	006525

EXTERNAL REFERENCES (BLOCK, NAME)

0006	SQRT
0007	NWDUS
0010	NIOIS
0011	NIO25
0012	NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000	000005	IOF	0001	000135	ZOL	0005	R	000000	AREA	0005	R	000074	AREA1	0005	R	000170	AREAK		
0005	R	000132	AREAO	0005	R	005060	CF	0005	R	006423	CGGTC	0005	R	006436	CGTANK	0005	R	006431	CLTANK
0005	R	005014	CONCT	0005	R	006443	CPJU	0005	R	005006	CSTAR	0005	R	006355	CVEL	0005	R	000036	DELXL
0005	R	000226	DIALI	0005	R	006277	DMVENT	0005	R	006360	ETAT	0003	R	000002	FB	0005	R	006370	F0PC
0005	R	006376	FBTC	0005	R	006362	FBWC	0005	R	005111	FRL	0003	R	000001	GC	0005	R	003132	HI
0005	R	003036	HO	0005	R	003322	HRAD	0005	I	005110	ICMON	0000	I	000000	II	0000	I	000001	IPROP
0005	I	005052	ISPT	0000	I	000002	JJ	0005	I	003606	JUN	0004	R	003413	KA	0004	R	004561	MACH
0005	I	005066	MEX	0005	I	004756	MR	0005	I	005102	MWC	0005	I	002552	NGR	0004	I	000100	NODEL
0004	I	000553	NPLINE	0005	I	002646	NPR	0005	I	002742	NRE	0005	R	000264	PB	0005	R	004764	PC
0005	R	004772	PCN	0005	R	005074	PE	0005	R	000272	PG	0005	R	003620	PGT	0003	R	000000	PI
0005	R	005036	PMR	0005	R	006241	POWC	0005	R	006350	POWP	0005	R	006343	POWT	0005	R	006300	PP1
0005	R	006305	PPO	0004	R	006721	PRE	0004	I	006707	PRIN	0004	I	006601	PROU	0005	R	006331	PT1
0005	R	006336	PTO	0005	R	006357	R	0004	R	005754	RFLAG	0004	R	005711	RGAS	0005	R	001422	RHOG
0005	R	006312	RPMT	0004	R	000000	S	0000	R	000004	T	0005	R	005044	TC	0005	R	006416	THOC
0005	R	006411	TPCG	0005	R	006404	TPCL	0004	R	001132	TTEMP	0005	R	006317	TT1	0005	R	006324	TYQ
0005	R	003226	TWALL	0005	R	006356	U	0005	R	003416	UAO	0005	R	003512	VEL	0000	R	000003	W
0004	R	003423	WDOTG	0005	R	006265	W1	0005	R	004750	WNOZ	0005	R	006253	WQ	0005	R	006361	WT
0005	R	006246	WTGC																

00100	1*	C	
00101	2*		SUBROUTINE PREG(I)
00101	3*	C	
00101	4*	C	
00103	5*		INTEGER PRIN,PROU
00103	6*	C	

```

00104 7* REAL KA, MACH
00104 8* C
00105 9* DIMENSION KA(2), RGAS(2), NPLINE(30), MACH(30,20), PRIN(10), PROU(10)
00105 10* *, WDOTG(30,20), TTEMP(30,20), PRE(10), NODEL(20)
00105 11* C
00106 12* COMMON /CONS/PI, GC, FB
00107 13* COMMON /INDATA/S(5000)
00107 14* C
00110 15* COMMON /COM/AREA(30), DELXL(30), AREAI(30), AREA0(30), AREAK(30)
00110 16* *, DIALI(30), PB(6), PG(30,20), RHOG(30,20), NGK(30,2)
00110 17* *, NPR(30,2), NRE(30,2), HO(30,2), HI(30,2), TWALL(30,2)
00110 18* *, HRAD(30,2), UAO(30,2), VEL(30,2), JUN(10), PGT(30,20)
00110 19* *, WNOZ(6), MR(6), PC(6), PCN(6,2), CSTAR(6), CONCT(3,6)
00110 20* *, PMR(6), TC(6), ISPT(6), CF(6), MEX(6), PE(6), MNC(6), ICMON
00110 21* *, FRL(30,20), POWC(5), WTGC(5), WO(10), WI(10), DNVENT, PPI(5)
00110 22* *, PPO(5), RPMT(5), TTI(5), TTO(5), PTI(5), PTO(5), POWT(5)
00110 23* *, POWP(5), CVEL, U, R, ETAT, WT, FBWC(6), FBPC(6)
00110 24* *, FBTC(6), TPCL(5), TPCG(5), THOC(5), CGGTC(6), CLTANK(5)
00110 25* *, CGTANK(5), CPJU(5,10)
00110 26* C
00111 27* EQUIVALENCE
00111 28* *, (S(1804), KA(1)), (S(3018), RGAS(1)), (S(364), NPLINE(1))
00111 29* *, (S(2418), MACH(1,1)), (S(3528), PRIN(1)), (S(3458), PROU(1))
00111 30* *, (S(1812), WDOTG(1,1)), (S(603), TTEMP(1,1)), (S(3538), PRE(1))
00111 31* *, (S(65), NODEL(1))
00111 32* *, (S(3053), RFLAG)
00111 33* C
00111 34* C PRESSURE REGULATOR
00111 35* C
00111 36* C PRIN = LINE CONNECTED TO PRESS REGULATOR INLET
00111 37* C PRIN = LINE CONNECTED TO PRESS REGULATOR INLET
00111 38* C PROU = LINE CONNECTED TO PRESS REGULATOR OUTLET
00112 39* II = PRIN(1)
00113 40* IPROP = NPLINE(II)
00114 41* JJ = NODEL(II)
00115 42* W = WDOTG(II, JJ)
00116 43* T = TTEMP(II, JJ)
00117 44* II = PROU(1)
00120 45* IPROP = NPLINE(II)
00121 46* JJ = 1
00121 47* C DENSITY OF GAS
00122 48* RHOG(II, JJ) = PRE(1) / (RGAS(IPROP) * T) * 144.
00122 49* C MACH NUMBER
00123 50* MACH(II, JJ) = 4 * W / (RHOG(II, JJ) * PI * DIALI(II) * 2 * SQRT
00123 51* * ( KA(IPROP) * GC * RGAS(IPROP) * T )) * 144.
00124 52* PG(II, JJ) = PRE(1)
00125 53* TTEMP(II, JJ) = T
00126 54* WDOTG(II, JJ) = W
00127 55* IF (RFLAG), 20,
00132 56* WRITE(6,10) I, II, JJ, PRIN(1)
00132 57* *, WDOTG(II, JJ), TTEMP(II, JJ), PRE(1), RGAS(IPROP)
00132 58* *, W, T, RHOG(II, JJ), PI
00132 59* *, DIALI(II), KA(IPROP), GC
00153 60* 10 FORMAT(//24X12HPREG-ROUTINE, 5X417, //2(1P8E15.7//)
00154 61* 20 RETURN
00155 62* END

```

31 AUG 71	09:25:23	02163000	14	62	(DELETED)
31 AUG 71	09:25:23	02164544	36	1	(DELETED)
		02164610	14	15	

PREG	CODE	SYMBOLIC	FOR,°	PREG,PREG
PREG		RELOCATABLE		
° HDG	°		FOR,°	PROPTY,PROPTY

3.2.47 PROPTY

31 AUG 71

9:28: 7: 93

FOR, PROPTY,PROPTY
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:07

SUBROUTINE PROPTY ENTRY POINT 000136

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000216
 0000 *DATA 000015
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 HPTD
 0004 HPTV
 0005 HPTTC
 0006 PTHEAT
 0007 OPTD
 0010 OPTV
 0011 OPTTC
 0012 OPTCP
 0013 H2OH2
 0014 NERR2s
 0015 NERR3s

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000011 10L 0001 000054 20L 0001 000116 30L 0003 R 000000 HPTD 0005 R 000000 HPTTC
 0004 R 000000 HPTV 0012 R 000000 OPTCP 0007 R 000000 OPTD 0011 R 000000 OPTTC 0010 R 000000 OPTV
 0006 R 000000 PTHEAT

00101 1* SUBROUTINE PROPTY (N,P,T,SV,MU,K,CP,PR)
 00103 2* REAL MU,K
 00103 3* CC THIS SUBROUTINE DOES PROPERTY LOOKUPS FOR
 00103 4* CC VARIOUS MATERIALS
 00104 5* GO TO (10,20,30),N
 00105 6* 10 CONTINUE
 00105 7* CC LOOKUP HYDROGEN DATA, N=1
 00105 8* C FUNCTION UNITS = HPTD = LBM / FT3
 00105 9* C = HPTV = LBF-HR / FT2
 00105 10* C = HPTTC = B / FT-HR-R
 00105 11* C = HPTCP = B / LBM-R
 00105 12* C SAME FOR OXYGEN
 00105 13* C
 00106 14* SV = 1. / HPTD(P,T) * 1728.
 00107 15* MU = HPTV(P,T) * 32.2 * 3600. / 12.
 00110 16* K = HPTTC(P,T) / 12. / 3600.
 00111 17* CP = PTHEAT(P,T,1)
 00112 18* PR = CP * MU / K

```

00113 19* RETURN
00114 20* 20 CONTINUE
00114 21* CC LOOKUP OXYGEN DATA, N=2
00115 22* SV = 1./ OPTD(P,T) * 1728.
00116 23* MU = OPTV(P,T) * 32.2 * 3600. / 12.
00117 24* K = OPTC(P,T) / 12. / 3600.
00120 25* CP = OPTCP(P,T)
00121 26* PR = CP * MU / K
00122 27* RETURN
00123 28* 30 . CONTINUE
00123 29* CC LOOKUP H2O-H2 FOR MR=1.0, N=3
00124 30* CALL H2OH2 (P,T,SV,MU,K,CP,PR)
00125 31* RETURN
00126 32* END

```

```

      END OF UNIVAC 1108 FORTRAN V COMPILATION.  0 *DIAGNOSTIC* MESSAGE(S)
      PROPTY      SYMBOLIC      30 APR 71  11:20:04  0  01520130  14  32  (DELETED)
      PROPTY CODE  RELOCATABLE  30 APR 71  11:20:04  1  01521030  24  1  (DELETED)
                                     0  01521060  14  15
@ HDG      @      FOR,* PTHEAT,PTHEAT

```

3.2.48 PTHEAT

6 FOR, * PTHEAT,PTHEAT
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:08

31 AUG 71

9:28: 8.278

FUNCTION PTHEAT ENTRY POINT 000617

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000626
0000	*DATA	000334
0002	*BLANK	000000
0003	SPHEAT	002432

EXTERNAL REFERENCES (BLOCK, NAME)

0004 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000137	100L	0001	000170	110L	0001	000173	120L	0001	000203	130L	0001	000227	140L					
0001	000232	150L	0001	000246	170L	0001	000277	180L	0001	000311	190L	0001	000351	20L					
0001	000353	200L	0001	000524	210L	0001	000540	220L	0001	000550	230L	0001	000234	232G					
0001	000602	240L	0001	000054	30L	0001	000064	40L	0001	000067	50L	0001	000104	60L					
0001	000107	70L	0001	000117	80L	0001	000122	90L	0000	R	000067	8P	0000	R	000133	BT			
0003	R	000000	CP	0000	R	000261	CTCP	0003	R	001215	CV	0000	R	000111	DP	0000	R	000155	DT
0000	R	000250	F	0000	R	000257	FF	0000	R	000251	FI	0000	R	000253	FP	0000	R	000255	FT
0000	I	000247	I	0000	I	000254	IF	0000	I	000256	IT	0000	I	000241	IS	0000	I	000260	J
0000	I	000023	JP	0000	I	000244	KTR	0000	I	000000	LOC	0000	I	000045	HX	0000	I	000245	N
0000	R	000242	P	0000	R	000177	PS	0000	R	000022	PTHEAT	0000	R	000243	T	0000	R	000227	TL
0000	R	000246	TH	0000	R	000252	TQ	0000	R	000213	TS								

00100	1*	CD	*****	PTHE0010
00100	2*	CD		PTHE0020
00100	3*	CD	PROGRAMMER AND DATE	PTHE0030
00100	4*	CD	NATIONAL BUREAU OF STANDARDS	PTHE0040
00100	5*	CD	1967	PTHE0050
00100	6*	CD		PTHE0060
00100	7*	CD	DOCUMENTATION AND DATE	PTHE0070
00100	8*	CD	J. I. PREWITT	PTHE0080
00100	9*	CD	DECEMBER 1970	PTHE0090
00100	10*	CD		PTHE0100
00100	11*	CD	PURPOSE	PTHE0110
00100	12*	CD	COMPUTES THE SPECIFIC HEAT OF HYDROGEN FOR EITHER	PTHE0120
00100	13*	CD	CONSTANT PRESSURE OR CONSTANT VOLUME.	PTHE0130
00100	14*	CD		PTHE0140
00100	15*	CD	USAGE	PTHE0150
00100	16*	CD	SH = PTHEAT (PRES,TEMP,KTRANS)	PTHE0160
00100	17*	CD		PTHE0170
00100	18*	CD	DESCRIPTION OF PARAMETERS	PTHE0180
00100	19*	CD		PTHE0190

```

00100 20* CD INPUT
00100 21* CD CALL SEQUENCE
00100 22* CD PRES = PRESSURE - PSIA
00100 23* CD TEMP = TEMPERATURE - O R
00100 24* CD KTRANS = KEY
00100 25* CD = 1 - CONSTANT PRESSURE
00100 26* CD = 2 - CONSTANT VOLUME
00100 27* CD = 3 - CP/CV
00100 28* CD COMMON
00100 29* CD UNKNOWN
00100 30* CD
00100 31* CD OUTPUT
00100 32* CD CALLING SEQUENCE
00100 33* CD PTHEAT - SPECIFIC HEAT OF HYDROGEN
00100 34* CD
00100 35* CD REMARKS AND RESTRICTIONS
00100 36* CD THE BLOCK DATA ROUTINE BLK2 MUST BE USED WITH THIS
00100 37* CD PROGRAM.
00100 38* CD THIS ROUTINE WAS OBTAINED FROM NASA/MSC.
00100 39* CD
00100 40* CD SUBPROGRAMS REQUIRED
00100 41* CD NONE
00100 42* CD
00100 43* CD METHOD
00100 44* CD VARIOUS CHECKS ARE MADE ON PRESSURE AND TEMPERATURE TO
00100 45* CD OBTAIN POINTERS FOR THE INTERPOLATION OF SPECIFIC HEAT.
00100 46* CD THIS ROUTINE WAS OBTAINED FROM NASA/MSC AND IS PART OF
00100 47* CD NBS COMPUTER PROGRAMS FOR THERMODYNAMIC AND TRANSPORT
00100 48* CD PROPERTIES OF HYDROGEN FROM 1 TO 5000 PSIA AND FOR
00100 49* CD TEMPERATURES FROM THE TRIPLE POINT (ABOUT 24.16 O R )
00100 50* CD TO 5000. O R . AUTHORS ARE W.J.HALL, R.D.MCCARTY AND
00100 51* CD H.M.RODER , NBS REPORT NO 9288 , AUGUST 18, 1967,
00100 52* CD FP 188 , NASA NO N67-35527
00100 53* CD
00100 54* CD . . . . .
00101 55* FUNCTION PTHEAT(PRES,TEMP,KTRANS)
00103 56* COMMON/SPHEAT/CP(653),CV(653)
00104 57* DIMENSION LOC(18),JP(18),MX(18),BP(18),DP(18),BT(18),PT(18),PS(12)
00104 58* 1,TS(12),TL(10)
00105 59* DATA PS/1.022,2.0,4.0,8.0,14.0,25.0,43.0,69.0,99.0,128.0,151.0,160./
00107 60* DATA TS/24.045,27.07,29.81,33.07,36.18,39.96,44.12,48.33,51.97,
00107 61* 154.79,56.72,57.46/
00111 62* DATA LOC/1.50,71.113,133.141,170.165,228,264,348,372,426,492,528,
00111 63* 1584,626,638/
00113 64* DATA JP/7.3,6.5,2.4,9.9,4.7,4.9,6.6,7.7,2.2/
00115 65* DATA MX/5.1,4.3,0.2,2.4,2.5,2.7,4.4,5.5,0.0/
00117 66* DATA BP/0.0,20.0,100.0,100.0,100.0,146.9,6.0,146.9,6.587,84.587,84
00117 67* 1.0,100.0,100.0,40.0,40.0,0.0,0./
00121 68* DATA BT/2600.0,2600.0,2600.0,2600.0,800.0,300.0,120.0,120.0,25.2,27.72,
00121 69* 181.0,25.0,56.0,26.0,41.0,25.0,25.0/
00123 70* DATA DP/5.0,40.0,200.0,1000.0,4900.0,2000.0,1175.68,293.92,1175.68,
00123 71* 1146.96,146.96,73.48,100.0,100.0,20.0,20.0,40.0,40.0/
00125 72* DATA DT/400.0,400.0,400.0,800.0,600.0,100.0,30.0,30.0,12.6,9.0,3.6,9.0,5.0,
00125 73* 15.0,4.0,8.0,4.0,8.0/
00127 74* DATA TL/24.846,27.175,29.310,31.029,33.176,34.962,36.672,38.317,
00127 75* 139.904,41.456/
00131 76* 10 P=PRES
00132 77* IF(P.LT.1.0) P=1.0

```

```

PTHE0240
PTHE0210
PTHE0220
PTHE0230
PTHE0240
PTHE0250
PTHE0260
PTHE0270
PTHE0280
PTHE0290
PTHE0300
PTHE0310
PTHE0320
PTHE0330
PTHE0340
PTHE0350
PTHE0360
PTHE0370
PTHE0380
PTHE0390
PTHE0400
PTHE0410
PTHE0420
PTHE0430
PTHE0440
PTHE0450
PTHE0460
PTHE0470
PTHE0480
PTHE0490
PTHE0500
PTHE0510
PTHE0520
PTHE0530
PTHE0540
PTHE0550
PTHE0560
PTHE0570
PTHE0580
PTHE0590
PTHE0600
PTHE0610
PTHE0620
PTHE0630
PTHE0640
PTHE0650
PTHE0660
PTHE0670
PTHE0680
PTHE0690
PTHE0700
PTHE0710
PTHE0720
PTHE0730
PTHE0740
PTHE0750
PTHE0760
PTHE0770

```

00134	78*	T=TEMP	PTHE0780
00135	79*	KTR=KTRANS	PTHE0790
00136	80*	IF (T.LT.126.) GO TO 90	PTHE0800
00140	81*	IF (T.LT.2600.) GO TO 50	PTHE0810
00142	82*	IF (T.GE.5000.) T=4999.99999	PTHE0820
00144	83*	IF (P.GE.100.) GO TO 30	PTHE0830
00146	84*	IF (P.GE.30.) GO TO 20	PTHE0840
00150	85*	N=1	PTHE0850
00151	86*	GO TO 200	PTHE0860
00152	87*	20 N=2	PTHE0870
00153	88*	GO TO 200	PTHE0880
00154	89*	30 IF (P.GE.1000.) GO TO 40	PTHE0890
00156	90*	N=3	PTHE0900
00157	91*	GO TO 200	PTHE0910
00160	92*	40 N=4	PTHE0920
00161	93*	GO TO 200	PTHE0930
00162	94*	50 IF (T.LT.300.) GO TO 70	PTHE0940
00164	95*	IF (T.LT.800.) GO TO 60	PTHE0950
00166	96*	N=5	PTHE0960
00167	97*	GO TO 200	PTHE0970
00170	98*	60 N=6	PTHE0980
00171	99*	GO TO 200	PTHE0990
00172	100*	70 IF (P.LT.1469.6) GO TO 80	PTHE1000
00174	101*	N=7	PTHE1010
00175	102*	GO TO 200	PTHE1020
00176	103*	80 N=8	PTHE1030
00177	104*	GO TO 200	PTHE1040
00200	105*	90 IF (P.LT.587.84) GO TO 120	PTHE1050
00202	106*	IF (P.LT.1469.6) GO TO 100	PTHE1060
00204	107*	N=9	PTHE1070
00205	108*	GO TO 190	PTHE1080
00206	109*	100 IF (P.LT.1028.72.AND.T.GE.72.0.AND.T.LT.90.0) GO TO 110	PTHE1090
00210	110*	N=10	PTHE1100
00211	111*	GO TO 190	PTHE1110
00212	112*	110 N=11	PTHE1120
00213	113*	GO TO 200	PTHE1130
00214	114*	120 IF (T.LT.81.) GO TO 130	PTHE1140
00216	115*	N=12	PTHE1150
00217	116*	GO TO 200	PTHE1160
00220	117*	130 IF (P.LT.160.) GO TO 150	PTHE1170
00222	118*	TM=((0.86867647E-7*P-.12613701E-3)*P+.10353383)*P+43.8056878	PTHE1180
00223	119*	IF (T.GT.TM) GO TO 140	PTHE1190
00225	120*	N=13	PTHE1200
00226	121*	GO TO 190	PTHE1210
00227	122*	140 N=14	PTHE1220
00230	123*	GO TO 200	PTHE1230
00231	124*	150 DO 160 I=2,12	PTHE1240
00234	125*	IF (P=PS(I)) 170,170,160	PTHE1250
00237	126*	160 CONTINUE	PTHE1260
00241	127*	I=12	PTHE1270
00242	128*	170 TM=TS(I-1)+(TS(I)-TS(I-1))*(P-PS(I-1))/(PS(I)-PS(I-1))	PTHE1280
00243	129*	IF (T.GE.TM) GO TO 180	PTHE1290
00245	130*	N=15	PTHE1300
00246	131*	IF (P.LT.40.) N=17	PTHE1310
00250	132*	GO TO 190	PTHE1320
00251	133*	180 N=16	PTHE1330
00252	134*	IF (P.LT.40.) N=18	PTHE1340
00254	135*	GO TO 200	PTHE1350


```

00255 136* 190 F=P/587.84 PTHE1360
00256 137* I=F PTHE1370
00257 138* IF(I.GT.8) PTHE1380
00261 139* F1=1 PTHE1390
00262 140* F=F-F1 PTHE1400
00263 141* TQ=(1.0-F)*TL(1+1)+F*TL(1+2) PTHE1410
00264 142* IF(T.LT.TQ) T=TQ PTHE1420
00266 143* 200 FP=(P-BP(N))/DP(N) PTHE1430
00267 144* IP=FP PTHE1440
00270 145* IF(IP.GT.MX(N)) IP=MX(N) PTHE1450
00272 146* FI=IP PTHE1460
00273 147* F=FP-FI PTHE1470
00274 148* FP=1.0-F PTHE1480
00275 149* FT=(T-BT(N))/DT(N) PTHE1490
00276 150* IT=FT PTHE1500
00277 151* FI=IT PTHE1510
00300 152* FF=FT-FI PTHE1520
00301 153* FT=1.0-FF PTHE1530
00302 154* I=IT*JP(N)+IP*LUC(N) PTHE1540
00303 155* J=1+JP(N) PTHE1550
00304 156* IF (KTR.EQ.2) GO TO 230 PTHE1560
00306 157* CTCF=FP*FT*CP(1)+F*FT*CP(1+1)+FP*FF*CP(J)+F*FF*CP(J+1) PTHE1570
00307 158* IF (N.LT.13.OR.N.GE.17) GO TO 220 PTHE1580
00311 159* IF (N.LT.15) GO TO 210 PTHE1590
00313 160* CTCF=CTCF/(187.506-P*ABS (T-TM)*28.13) PTHE1600
00314 161* GO TO 220 PTHE1610
00315 162* 210 CTCF=CTCF/(ABS (T-TM)/1.8+ABS (P-187.506)*.008008982) PTHE1620
00316 163* 220 IF (KTR.GE.2) GO TO 230 PTHE1630
00320 164* PTHEAT=CTCF PTHE1640
00321 165* GO TO 240 PTHE1650
00322 166* 230 PTHEAT=FP*FT*CV(1)+F*FT*CV(1+1)+FP*FF*CV(J)+F*FF*CV(J+1) PTHE1660
00323 167* IF (KTR.LT.3) GO TO 240 PTHE1670
00325 168* PTHEAT=CTCF/PTHEAT PTHE1680
00326 169* 240 CONTINUE PTHE1690
00327 170* RETURN PTHE1700
00330 171* END PTHE1710

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

PTHEAT SYMBOLIC
PTHEAT CODE RELOCATABLE

01 MAR 71	18:48:48	0	01575260	14	180	(DELETED)
30 APR 71	11:20:06	1	01521402	24	1	(DELETED)
		0	01521432	14	60	

@ HDG @ FOR, R2DP,R2DP

31 AUG 71

9:28:10.422

@ FOR,* R2DP,R2DP
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:10

SUBROUTINE R2DP ENTRY POINT 000011

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000015
 0000 *DATA 000006
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

00101 1* SUBROUTINE R2DP (R, D)
 00101 2* C.....
 00103 3* DOUBLE PRECISION
 00103 4* *D
 00103 5* C.....
 00104 6* D = R
 00105 7* RETURN
 00106 8* END

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

R2DP	SYMBOLIC	30 APR 71	11:20:07	0	01523142	14	8	(DELETED)
R2DP	CODE	30 APR 71	11:20:07	1	01523322	24	1	(DELETED)
				0	01523352	14	2	

@ HDG @ FOR,* SAT,SAT

6 FOR, SAT, SAT
 UNIVAC 1108 FORTRAN V LEVEL 22 018 F5018H
 THIS COMPILATION WAS DONE ON 31 JUL 71 AT 09:28:11

31 AUG 71

9:28:11.602

SUBROUTINE SAT ENTRY POINT 000040

STORAGE-USED (BLOCK, NAME, LENGTH)

0001 *CODE 000052
 0000 *DATA 000132
 0002 *BLANK 000060

EXTERNAL REFERENCES (BLOCK, NAME)

0003 BETA
 0004 NERR2\$
 0005 NERR3\$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000010	10L	0001	000022	20L	0003	R	000000	BETA	0000	I	000120	IS	0000	I	000121	NPH		
0000	I	000122	NPO	0000	R	000024	PH	0000	R	000074	PO	0000	R	000000	TH	0000	R	000050	TO

```

00101 10 SUBROUTINE SAT ( IFLUID, PX, TSAT )
00101 20 C
00101 30 C OBTAIN SATURATION TEMPERATURE AT INPUT PRESSURE PX
00101 40 C IFLUID = 1=HYDROGEN, 2=OXYGEN
00101 50 C USE LINEAR INTERPOLATION OF SATURATION P-T TABLES
00101 60 C
00103 70 DIMENSION TH(20), PH(20), TO(20), PO(20)
00104 80 DATA TH / 34.26, 36.49, 38.436, 41.291, 43.529, 45.40, 47.022,
00104 90 1 48.464, 49.768, 50.962, 52.067, 56.6, 8*0./
00106 100 DATA NPH / 12/, PH / 10., 14.696, 20., 30., 40., 50., 60., 70.,
00106 110 1 80., 90., 100., 150., 8*0./
00111 120 DATA TO / 185., 190., 195., 200., 205., 210., 215., 220., 225.,
00111 130 1 230., 235., 240., 245., 250., 255., 260., 265., 270., 275.,
00111 140 2 278.586 /
00113 150 DATA NPO / 20/, PO / 46.261, 57.286, 70.163, 85.040, 102.09,
00113 160 1 121.51, 143.49, 168.20, 195.82, 226.59, 260.66, 298.26, 339.62,
00113 170 2 384.96, 434.55, 488.66, 547.69, 612.08, 653.06, 737.06 /
00113 180 C
00116 190 GO TO (10,20), IFLUID
00117 200 10 TSAT = BETA (TH, PH, PX, NPH)
00120 210 RETURN
00121 220 20 TSAT = BETA (TO, PO, PX, NPO)
00122 230 RETURN
00123 240 END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION. 0 *DIAGNOSTIC* MESSAGE(S)
 SAT SYMBOLIC 14 JUN 71 15:04:53 0 01602210 14 24 (DELETED)

	FOR,* SAT,SAT
SAT	CODE RELOCATABLE
HDG	FOR,* SQZB,SQZB .

DATE 310871 PAGE 246

14 JUN 71	15:04:53	1	01602730	24	1	(DELETED)
		0	01602760	14	13	

6 F04, SQZB, SQZB
 UNIVAC 1108 FORTRAN V LEVEL 22 018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:13

31 AUG 71

9:28:12.955

SUBROUTINE SQZB ENTRY POINT 000063

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000077
 0000 *DATA 000020
 0002 *BLANK 000000

EXTERNAL REFERENCES (BLOCK, NAME)

0003 NERR3S

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000023 1L 0001 000010 110G 0001 000044 126G 0001 000047 3L 0000 000002 1
 0000 000003 K 0000 000000 NBLNK 0000 000001 NCHAR

188

```

00101 1* SUBROUTINE SQZB(NCOL, N)
00101 2* C.....TRNSQZ SQUEEZES BLANKS FROM AN UNPACKED PHRASE
00101 3* C.....
00101 4* C.....
00101 5* C.....NCOL = PHRASE ARRAY (ONE CHARACTER PER WORD)
00101 6* C.....N = NUMBER OF COLUMNS ENTERING AND NUMBER OF NON-BLANK COLUMNS
00101 7* C..... EXITING WITH.
00101 8* C.....
00103 9* C..... DIMENSION
00103 10* * NCOL(1)
00103 11* C.....
00104 12* DATA
00104 13* * NBLNK / 1H /
00104 14* C.....
00104 15* C.....LEFT ADJUST NON-BLANK WORDS IN NCOL
00106 16* NCHAR = 0
00107 17* DO 1 I=1,N
00112 18* IF(NCOL(I).EQ.NBLNK) GO TO 1
00114 19* NCHAR = NCHAR + 1
00115 20* NCOL(NCHAR) = NCOL(I)
00116 21* 1 CONTINUE
00116 22* C.....
00116 23* C.....
00120 24* IF(NCHAR.EQ.0) GO TO 3
00122 25* IF(NCHAR.EQ.N) GO TO 3
00124 26* K = NCHAR + 1
00125 27* DO 2 I=K,N
00130 28* 2 NCOL(I) = NBLNK
00132 29* 3 N = NCHAR

```

6 FOR,* SQZB,SQZB

DATE 310871 PAGE 248

00133 30* RETURN
00134 31* END

END OF UNIVAC 1108 FORTRAN V COMPILATION.

0 *DIAGNOSTIC* MESSAGE(S)

SQZB SYMBOLIC
SQZB CODE RELOCATABLE

30 APR 71	11:20:08	0	01523406	14	31	(DELETED)
30 APR 71	11:20:08	1	01524270	24	1	(DELETED)
		0	01524320	14	8	

6 HDG 6 FOR,* TANK,TANK

SUBROUTINE TANK ENTRY POINT 000271

STORAGE USED (BLOCK, NAME, LENGTH)

0001 *CODE 000302
0000 *DATA 000066
0002 *BLANK 000000
0003 ARRAY 000017
0004 GAMMA 000025
0005 INDATA 011610

EXTERNAL REFERENCES (BLOCK, NAME)

0006 INITAL
0007 BETA
0010 INTEG
0011 SQRT
0012 NHDUS
0013 NIDIS
0014 NID25
0015 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000004 1216	0001 000246 15L	0001 000242 1716	0001 000252 1776	0000 000017 900F
0000 000027 901F	0003 R 000000 A	0000 R 000003 ALPHA	0003 R 000016 AVENT	0007 R 000000 BETA
0000 R 000010 CP	0003 R 000006 CP1	0003 R 000007 CP2	0000 R 000011 CV	0000 R 000012 DHIN
0000 R 000013 DHOUT	0000 R 000014 DHVENT	0003 R 000021 DHIN	0003 R 000022 DHOUT	0003 R 000023 DHV.CNT
0000 R 000004 DM1	0000 R 000005 DM2	0003 R 000024 DQIN	0000 R 000016 DU	0003 R 000017 DWIN
0000 R 000006 DNET	0000 R 000015 DWORK	0003 R 000020 DHOUT	0004 R 000012 FG	0004 R 000000 G
0003 R 000012 GAM	0000 I 000002 I	0000 I 000000 IS	0000 R 000001 MTOT	0003 R 000041 M1
0003 R 000042 M2	0004 I 000024 NG	0003 R 000001 P	0003 R 000015 PVENT	0003 R 000013 R
0005 R 005754 RFLAG	0003 R 000004 RHOL	0003 R 000010 R1	0003 R 000011 R2	0005 R 000000 S
0003 R 000002 T	0003 R 000000 TIME	0003 R 000014 TIN	0003 R 000044 U	0000 R 000007 VGAS
0003 R 000005 VTANK	0003 R 000043 W	0003 000003 WOL		

00101 10 SUBROUTINE TANK (B)
00101 20 C
00101 30 C THIS SUBROUTINE COMPUTES THE TANK PRESSURE AND TEMPERATURE
00101 40 C THE GAS MIXTURE IS ASSUMED THERMODYNAMICALLY AND CALORICALLY PERFECT
00101 50 C GAS AND LIQUID FLOWRATES INTO AND OUT OF TANK ARE REQUIRED
00101 60 C HEATING RATE INTO TANK IS INPUT
00101 70 C THE STATE OF THE TANK IS OBTAINED FROM ENERGY AND MASS BALANCES
00101 80 C PROGRAM WRITTEN FEBRUARY 23, 1971 P.J. HEINMILLER
00101 90 C
00103 100 COMMON /ARRAY/ A

```

00104 11*   DIMENSION A(39), B(39)
00105 12*   EQUIVALENCE (A(1),TIME), (A(2),P), (A(3),T),
00105 13*   1 (A(4),WOL ), (A(5),RHOL ), (A(6),VTANK ), (A(7),CP1 ),
00105 14*   2 (A(8),CP2 ), (A(9),R1 ), (A(10),R2 ), (A(11),GAM ),
00105 15*   3 (A(12),R ), (A(13),TIN ), (A(14),PVENT ), (A(15),AVENT ),
00105 16*   4 (A(16),DMIN ), (A(17),DMOUT ), (A(18),DMIN ), (A(19),DMOUT ),
00105 17*   5 (A(20),DMVENT ), (A(21),DQIN ), (A(34),M1 ), (A(35),M2 ),
00105 18*   6 (A(36),W ), (A(37),U )
00106 19*   COMMON /GAMMA/ G(10), FG(10), NG
00106 20*   C
00107 21*   COMMON /INDATA/ S(5000)
00107 22*   C
00110 23*   EQUIVALENCE
00110 24*   * (S(3053),RFLAG)
00110 25*   C
00111 26*   DATA G / 1.10, 1.15, 1.20, 1.25, 1.30, 1.36, 1.40, 1.50, 1.60,0. /
00113 27*   DATA FG/.6590,.6848,.7104,.7356,.7608,.7906,.8102,.8586,.9062,0. /
00115 28*   DATA NG/ 9. /
00117 29*   REAL M1, M2, MTOT
00120 30*   DO 10 I=1,39
00123 31*   10 A(I)=B(I)
00125 32*   IF (TIME .LT. 0.) RETURN
00127 33*   *DIAGNOSTIC* THE TEST FOR EQUALITY BETWEEN NON-INTEGERS MAY NOT BE MEANINGFUL.
00127 34*   C IF (TIME .EQ. 0.) CALL INITAL
00131 35*   ALPHA = M2 / (M1+M2)
00132 36*   IF (P.GT.PVENT) DMVENT = AVENT *P* BETA (FG,G,GAM,NG) /
00132 37*   1 SQRT ( 32*2 * GAM * R * T * 778.156 )
00132 38*   C COMPUTE SPECIE FLOWRATES
00134 39*   DM1 = (ALPHA - 1.) * (DMOUT + DMVENT)
00135 40*   DM2 = DMIN - ALPHA * (DMOUT + DMVENT)
00136 41*   CALL INTEG ( 1,DM1,TIME )
00137 42*   CALL INTEG ( 2,DM2,TIME )
00140 43*   MTOT = M1 + M2
00141 44*   DWNET = DMIN - DMOUT
00142 45*   CALL INTEG (3,DWNET,TIME )
00143 46*   VGAS = VTANK * W / RHOL
00144 47*   CP =(CP1 * M1 + CP2 * M2) / MTOT
00145 48*   R = ( R1 * M1 + R2 * M2) / MTOT
00146 49*   CV = CP * R
00147 50*   GAM = CP / CV
00147 51*   C PERFORM ENERGY BALANCE
00150 52*   DHIN = DMIN * CP1 * TIN
00151 53*   DHOUT = DMOUT * CP * T
00152 54*   DHVENT = DMVENT * CP * T
00153 55*   DWORK = P * DWNET / RHOL * 144. / 778.156
00154 56*   DU = DQIN + DHIN - DHOUT - DHVENT + DWORK
00155 57*   CALL INTEG (4,DU,TIME )
00156 58*   T = U / (MTOT * CV)
00157 59*   F = MTOT * R * T / VGAS * 778.156 / 144
00160 60*   IF (RFLAG),15,
00163 61*   WRITE (6,900) TIME
00166 62*   900 FORMAT ( 1H0,1CX,25HSUBROUTINE TANK AT TIME =, F10.1 / )
00167 63*   WRITE (6,901) A
00175 64*   901 FORMAT ( 5X, 10E11.4 )
00176 65*   15 DO 20 I=1,39
00201 66*   20 B(I) = A(I)
00203 67*   RETURN

```


00204 68* END

END OF UNIVAC 1108 FORTRAN COMPILATION.

TANK SYMBOLIC
TANK CODE RELOCATABLE

1 *DIAGNOSTIC* MESSAGE(S)

23 JUN 71	21:26:25	0	01717200	14	68	(DELETED)
23 JUN 71	21:26:25	1	01721070	36	1	(DELETED)
		0	01721134	14	27	

6 HDG 6 FOR,* TANKD,TANKD

3.2.53 TANKD (TANK INTERFACE ROUTINE)

@ FOR, * TANKD, TANKD
 UNIVAC 1106 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:15

31 AUG 71

9:28:15.563

SUBROUTINE TANKD ENTRY POINT 000502

TANKC ENTRY POINT 000507

STORAGE USED (BLOCK, NAME, LENGTH)

```

0001 *CODE 000514
0000 *DATA 000346
0002 *BLANK 000000
0003 CONS 000003
0004 INDATA 011610
0005 COM 0006525
0006 TKOUT 000074

```

EXTERNAL REFERENCES (BLOCK, NAME)

```

0007 OPTD
0010 HPTD
0011 TANK
0012 NERR2$
0013 SQRT
0014 NERR3$

```

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000202 11L	0001 000007 116G	0001 000215 12L	0001 000227 15L	0001 000234 16L
0001 000241 17L	0001 000037 20L	0001 000067 30L	0001 000114 40L	0001 000135 50L
0001 000161 60L	0001 000330 61L	0001 000350 62L	0001 000430 63L	0001 000450 64L
0000 R 000001 A	0005 R 000000 AREA	0005 R 000074 AREAI	0005 R 000170 AREAK	0005 R 000132 AREAO
0005 R 005060 CF	0005 R 006423 CGGTC	0005 R 006436 CGTANK	0005 R 006431 CLTANK	0005 R 005014 CONCT
0005 R 006443 CPJU	0005 R 005006 CSTAR	0004 006531 CTANK	0005 R 006355 CVEL	0005 R 000036 DELXL
0005 R 000226 DIALI	0005 R 006277 DMVENT	0004 R 006550 DQIN	0005 R 006360 ETAT	0003 R 000002 FB
0005 R 006370 FBPC	0005 R 006376 FBTC	0005 R 006362 FBWC	0005 R 005111 FRL	0003 R 000001 GC
0005 R 003132 HI	0005 R 003036 HO	0010 R 000000 HPTD	0005 R 003322 HRAD	0005 I 005110 ICHON
0000 I 000305 II	0000 I 000310 IPROP	0005 I 005052 ISPT	0000 I 000306 JJ	0005 I 003606 JUN
0000 I 000304 K	0004 R 003413 KA	0004 I 006431 LDMI	0004 I 006536 LDMQ	0004 I 006517 LDW1
0004 I 006524 LDW0	0004 R 004561 MACH	0005 I 005066 MEX	0005 I 004756 MR	0005 I 005102 MAC
0005 I 002552 NGR	0004 I 000100 NODEL	0004 I 000553 NPLINE	0005 I 002646 NPR	0005 I 002742 NRE
0007 R 000000 OPTD	0004 R 006346 P	0005 R 000264 PB	0005 R 004764 PC	0005 R 004772 PCN
0005 R 005074 PE	0005 R 000272 PG	0005 R 003620 PGT	0003 R 000000 PI	0005 R 005036 PMR
0005 R 006241 POWC	0005 R 006350 POWP	0005 R 006343 POWT	0005 R 006300 PPI	0005 R 006305 PPO
0005 R 006331 PTI	0005 R 006336 PTO	0005 R 006357 R	0004 005711 RGAS	0000 R 000311 RGAST
0005 R 001422 RHOG	0004 R 000546 RHOL	0005 R 006312 RPMT	0004 R 000000 S	0005 R 005044 TC
0005 R 006416 THOC	0004 R 000611 TIME	0000 R 000307 TIN	0006 R 000012 TKGAM	0006 R 000000 TKHTOT
0006 R 000024 TKHYNT	0004 R 000062 TKP	0006 R 000017 TKRGAS	0006 R 000005 TKRHOL	0006 R 000067 TKT
0006 R 000055 TKTIME	0004 R 010133 TLIQ	0005 R 006411 TPCG	0005 R 006404 TPCL	0004 R 006574 TTANK
0004 R 001132 TTEMP	0005 R 006317 TTI	0005 R 006324 TTO	0004 R 002262 TTTEMP	0005 R 003226 TALL
0005 R 006356 U	0005 R 003416 UAO	0005 R 003512 VEL	0004 R 003423 WDOTG	0006 R 000031 WGASI
0006 R 000036 WGASO	0005 R 006265 WI	0006 R 000043 WLIQI	0006 R 000050 WLIQU	0005 R 004750 WMOZ

0005 R 006253 #0

0005 R 006361 #1

0005 R 006246 #TGC

0000 I 0000 #

```

00101 1* SUBROUTINE TANKD(1)
00101 2* C
00101 3* CC SUBROUTINE TANK DRIVER
00101 4* CC LDM1 = NUMBER OF LINE CONNECTED TO INLET GAS TANK I
00101 5* CC LDM0 = NUMBER OF LINE CONNECTED TO OUTLET GAS TANK I
00101 6* CC LDW0 = NUMBER OF LINE CONNECTED TO OUTLET LIQUID TANK I
00101 7* CC LDW1 = NUMBER OF LINE CONNECTED TO INLET LIQUID TANK I
00103 8* COMMON/CONS/PI,GC,FB
00104 9* REAL MACH,KA
00104 10* C
00105 11* INTEGER Z
00105 12* C
00106 13* DIMENSION A(39,5),P(5),NODEL(20),WDOTG(30,20),TTTEMP(30,20)
00106 14* *, LDM1(5),LDM0(5),LDW1(5),LDW0(5)
00106 15* *, CTANK(5),TTEMP(30,20),DQIN(5)
00106 16* *, KA(2),RGAS(2),NPLINE(30)
00106 17* *, TTANK(5),MACH(30,20)
00106 18* *, TLIQ(5)
00106 19* C
00107 20* COMMON /INDATA/ S(5000)
00107 21* C
00110 22* COMMON /COM/AREA(30),DELXL(30),AREAI(30),AREAO(30),AREAK(30)
00110 23* *, DIALI(30),PB(6),PG(30,20),RHOG(30,20),NGR(30,2)
00110 24* *, NPR(30,2),NRE(30,2),HO(30,2),HI(30,2),TWALL(30,2)
00110 25* *, HRAD(30,2),UAO(30,2),VEL(30,2),JUN(10),PGT(30,20)
00110 26* *, XNOZ(6),MR(6),PC(6),PCN(6,2),CSTAR(6),CONCT(3,6)
00110 27* *, PMR(6),TC(6),ISPT(6),CF(6),HEX(6),PE(6),MHC(6),ICMON
00110 28* *, FRL(30,20),POWC(5),WTGC(5),WO(10),WI(10),OMVENT,PPI(5)
00110 29* *, PPO(5),RPMT(5),TTI(5),TTO(5),PTI(5),PTO(5),POWT(5)
00110 30* *, POWP(5),CVEL,U,R,ETAT,WT,FBWC(6),FBPC(6)
00110 31* *, FBTC(6),TPCL(5),TPCG(5),THOC(5),CGGTC(6),CLTANK(5)
00110 32* *, CGTANK(5),CPJU(5,10)
00110 33* C
00111 34* COMMON /TKOUT/ TKMTOT(5),TKRHOL(5),TKGAM(5),TKRGAS(5),TKMVNT(5),
00111 35* *, W GAS(5),AGASO(5),WLIQ(5),WLIQO(5),TKTIME(5),TKP(5)
00111 36* *, TKT(5)
00112 37* EQUIVALENCE
00112 38* *, (S(3413),LDW0(1)), (S(3418),CTANK(1)), (S(3423),LDM0(1))
00112 39* *, (S(603),TTEMP(1,1)), (S(3354),LDW1(1)), (S(3408),LDW1(1))
00112 40* *, (S(3433),DQIN(1)), (S(3319),P(1)), (S(65),NODEL(1))
00112 41* *, (S(1812),WDOTG(1,1)), (S(1203),TTTEMP(1,1))
00112 42* *, (S(359),RHOL(1))
00112 43* *, (S(3453),TTANK(1))
00112 44* *, (S(1804),KA(1)), (S(3018),RGAS(1)), (S(364),NPLINE(1))
00112 45* *, (S(2418),MACH(1))
00112 46* *, (S(394),TIME)
00112 47* *, (S(4188),TLIQ)
00112 48* C
00113 49* IF (Z.EQ.1) GO TO 20
00115 50* DO 10 K=1,5
00120 51* A( 2,K) = S(K+3318)
00121 52* A( 3,K) = S(K+3452)
00122 53* A( 4,K) = S(K+3362)

```

```

00123 54*      A( 6,K) = S(K+3372)
00124 55*      A( 7,K) = S(K+3377)
00125 56*      A( 8,K) = S(K+3382)
00126 57*      A( 9,K) = S(K+3387)
00127 58*      A(10,K) = S(K+3392)
00130 59*      A(14,K) = S(K+3397)
00131 60*      A(15,K) = S(K+3402)
00132 61*      10 CONTINUE
00132 62*      C SET CONSTANTS FOR TANK ROUTINE
00134 63*      Z = Z + 1
00135 64*      20 CONTINUE
00136 65*      A(18,1) = 0.
00137 66*      IF (LDM1(1),EQ.0) GO TO 30
00141 67*      I1 = LDM1(1)
00142 68*      JJ = NODEL(I1)
00143 69*      A(18,1) = WDOTG(I1,JJ)
00144 70*      TIN = TTEMP(I1,JJ)
00145 71*      A(13,1) = TTEMP(I1,JJ)
00146 72*      30 CONTINUE
00147 73*      IPROP = 0
00150 74*      A(16,1) = 0.
00151 75*      IF (LDWI(1),EQ.0) GO TO 40
00153 76*      I1 = LDWI(1)
00154 77*      JJ = NODEL(I1)
00155 78*      A(16,1) = WDOTG(I1,JJ)
00156 79*      IPROP = NPLINE(I1)
00157 80*      40 CONTINUE
00160 81*      A(19,1) = 0.
00161 82*      IF (LDMO(1),EQ.0) GO TO 50
00163 83*      I1 = LDMO(1)
00164 84*      JJ = 1
00165 85*      A(19,1) = WDOTG(I1,JJ)
00166 86*      50 CONTINUE
00167 87*      A(17,1) = 0.
00170 88*      IF (LDHO(1),EQ.0) GO TO 60
00172 89*      I1 = LDHO(1)
00173 90*      JJ = 1
00174 91*      A(17,1) = WDOTG(I1,JJ)
00175 92*      IPROP = NPLINE(I1)
00176 93*      60 CONTINUE
00177 94*      A(1,1) = TIME
00200 95*      A(21,1) = OGIN(1)
00201 96*      IF (IPROP,EQ.0) GO TO 16
00201 97*      C COMPUTE FLUID DENSITY
00203 98*      GO TO (11,12), IPROP
00204 99*      11 RHOL = OPTD (P(1),TLIQ(I))
00205 100*      GO TO 15
00206 101*      12 RHOL = HPTD (P(1),TLIQ(I))
00207 102*      15 CONTINUE
00210 103*      A(5,1) = RHOL
00211 104*      GO TO 17
00212 105*      16 A(4,1) = 0.
00213 106*      A(5,1) = 1.
00214 107*      17 CONTINUE
00215 108*      CALL TANK(A(1,1))
00216 109*      P(1) = A(2,1)
00217 110*      TTANK(1) = A(3,1)
00220 111*      TKTIME(1) = A(1,1)

```

```

00221 112* TKP (I) = A(1,1)
00222 113* PKT(I) = A(1,1)
00223 114* TKMTOT(I) = A(14,1) + A(35,1)
00224 115* TKRHOL(I) = A(4,1)
00225 116* TKGAM(I) = A(11,1)
00226 117* TKRGAS(I) = A(12,1)
00227 118* TKMVT(I) = A(20,1)
00230 119* WLIQ(I) = A(16,1)
00231 120* WLIQO(I) = A(17,1)
00232 121* WGAS(I) = A(18,1)
00233 122* W GASO(I) = A(19,1)
00234 123* II = LDH1(I)
00235 124* JJ = NODEL(II)
00236 125* IF (II.EQ.0) GO TO 61
00240 126* CGTANK(I) = 1. - PG(II,JJ) / P(I)
00241 127* 61 CONTINUE
00242 128* II = LDW1(I)
00243 129* JJ = NODEL(II)
00244 130* IF (II.EQ.0) GO TO 62
00246 131* CLTANK(I) = 1. - PG(II,JJ) / P(I)
00247 132* 62 CONTINUE
00250 133* JJ = 1
00251 134* II = LDH0(I)
00252 135* IF (II.EQ.0) GO TO 63
00254 136* TTEMP(II,JJ) = A(3,1)
00255 137* PG(II,JJ) = A(2,1)
00256 138* C DENSITY OF GAS
00256 139* RGAST = A(12,1) * 778.2
00257 140* RHOG(II,JJ) = PG(II,JJ) / (RGAST * TTEMP(II,JJ)) * 144.
00260 141* IPROP = NPLINE(II)
00260 142* C MACH NUMBER
00261 143* MACH(II,JJ) = 4. * WDOTG(II,JJ) / (RHOG(II,JJ) * PI * DIALI(II) * 2. * SQRT
00261 144* * (KA(IPROP) * GC * RGAST * TTEMP(II,JJ)) * 144.
00262 145* 63 CONTINUE
00263 146* II = LDW0(I)
00264 147* IF (II.EQ.0) GO TO 64
00266 148* PG(II,JJ) = A(2,1)
00267 149* TTEMP(II,JJ) = TLIQ(I)
00270 150* 64 CONTINUE
00271 151* ENTRY TANKC(I)
00273 152* RETURN
00274 153* END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

D *DIAGNOSTIC* MESSAGE(S)

TANKD SYMBOLIC
TANKD CODE RELOCATABLE

31 AUG 71 09:25:25
31 AUG 71 09:25:25

0 02165132
1 02171270
0 02171350

14 153 (DELETED)
48 1 (DELETED)
14 37

@ HDG @ FOR, * TEST, TEST

@ FOR,* TEST,TEST

DATE 310871 PAGE 256

@ FOR,* TEST,TEST
INPUT SOURCE LANGUAGE ELEMENT NOT AVAILABLE
@ HDG @ FOR,* THERM,THERM

31 AUG 71

9128:18.142

FOR, * THERM, THERM
 UNIVAC 1108 FORTRAN V LEVEL 22 0016 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:18

31 AUG 71

9:28:18.185

FUNCTION OPTD ENTRY POINT 000705

OPDIT ENTRY POINT 000737

OPTIT ENTRY POINT 000763

OPDIC ENTRY POINT 001015

OPTIC ENTRY POINT 001041

OPDH ENTRY POINT 001073

OPTH ENTRY POINT 001117

OPDCV ENTRY POINT 001151

OPTCV ENTRY POINT 001175

OPDCP ENTRY POINT 001227

OPTCP ENTRY POINT 001253

OPDT ENTRY POINT 001305

OPTV ENTRY POINT 001331

OPTTC ENTRY POINT 001363

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	001415
0000	*DATA	000116
0002	*BLANK	000000
0003	TPCB	021661

EXTERNAL REFERENCES (BLOCK, NAME)

0004	BINSER
0005	NADUS
0006	N1015
0007	N1025
0010	NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000117	10L	0001	000325	100L	0001	000353	105L	0001	000407	106L	0001	000405	107L
0001	000417	110L	0001	000516	120L	0001	000522	130L	0001	000530	150L	0001	000560	170L
0001	000602	180L	0001	000614	190L	0001	000123	20L	0001	000636	200L	0001	000640	210L
0001	000641	220L	0001	000646	245L	0001	000650	250L	0001	000166	255G	0000	000026	260F

00100 46. CD CALLING SEQUENCE THER0460
 00100 47. CD 0 - DENSITY - LBM/FT**3 THER0470
 00100 48. CD 0P - ISOTHERM DERIVATIVE - PSIA/LBM FT**3 THER0480
 00100 49. CD OPTIC - ISOCHORE DERIVATIVE - PSIA/O R THER0490
 00100 50. CD OPTH - ENTHALPY - BTU/LBM THER0500
 00100 51. CD OPTCV - SPECIFIC HEAT AT CONSTANT VOLUME - BTU/LBM/O R THER0510
 00100 52. CD OPTCP - SPECIFIC HEAT AT CONSTANT PRESSURE - BTU/LBM/O R THER0520
 00100 53. CD OPOIT - ISOTHERM DERIVATIVE - PSIA/LBM FT**3 THER0530
 00100 54. CD OPDIC - ISOCHORE DERIVATIVE - PSIA/O R THER0540
 00100 55. CD OPDH - ENTHALPY - BTU/LBM THER0550
 00100 56. CD OPDCV - SPECIFIC HEAT AT CONSTANT VOLUME - BTU/LBM/O R THER0560
 00100 57. CD OPDCP - SPECIFIC HEAT AT CONSTANT PRESSURE - BTU/LBM/O R THER0570
 00100 58. CD OPTV - VISCOSITY - LBF HR/FT/FT THER0580
 00100 59. CD OPTTC - THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/O R THER0590
 00100 60. CD COMMON THER0600
 00100 61. CD NONE THER0610
 00100 62. CD CARD THER0620
 00100 63. CD NONE THER0630
 00100 64. CD PRINT THER0640
 00100 65. CD IF ONE OF THE INPUT VARIABLES IS OUT OF RANGE THEN AN THER0650
 00100 66. CD ERROR MESSAGE IS PRINTED WITH ITS VALUE. THER0660
 00100 67. CD PRESURE IS OUT OF RANGE THER0670
 00100 68. CD TEMPERATURE IS OUT OF RANGE THER0680
 00100 69. CD DENSITY IS OUT OF RANGE THER0690
 00100 70. CD TAPE THER0700
 00100 71. CD REMARKS AND RESTRICTIONS THER0710
 00100 72. CD THIS SUBPROGRAM NEEDS THE TWO BLOCK DATA ROUTINES THER0720
 00100 73. CD TPOCB1 AND TPOCB2, THER0730
 00100 74. CD IF THIS SUBPROGRAM IS EVER OVERLAYED THE COMMON BLOCK THER0740
 00100 75. CD TPOCB SHOULD BE PLACED IN THE MAIN LINK AND THE INTERNAL THER0750
 00100 76. CD VARIABLES JJ, JK, K, A, B, AB, AC, AND IERR SHOULD BE THER0760
 00100 77. CD PLACED IN A COMMON BLOCK IN THE MAIN LINK. THER0770
 00100 78. CD THE TEMPERATURE ARRAY FOR VISCOSITY AND THERMAL THER0780
 00100 79. CD CONDUCTIVITY IS DIFFERENT THEN THE ONE FOR THE OTHER THER0790
 00100 80. CD PROPERTIES AND THEREFORE KEY SHOULD BE SET TO ZERO THER0800
 00100 81. CD BEFORE REFERENCING OPTV OR OPTTC. THER0810
 00100 82. CD THER0820
 00100 83. CD THER0830
 00100 84. CD THER0840
 00100 85. CD SUBPROGRAMS REQUIRED THER0850
 00100 86. CD BINSER THER0860
 00100 87. CD THER0870
 00100 88. CD METHOD THER0880
 00100 89. CD THIS ROUTINE PREFORMS A TABLE LOOK UP TO OBTAIN A VALUE THER0890
 00100 90. CD FOR ONE OF THE THERMODYNAMIC PROPERTIES OF OXYGEN THER0900
 00100 91. CD DESCRIBED IN THE OUTPUT SECTION. IT USES EITHER THER0910
 00100 92. CD PRESSURE AND TEMPERATURE OR PRESSURE AND DENSITY AS THER0920
 00100 93. CD INPUT TO FIND THE INDICES FOR THE PROPER RANGES. THEN THER0930
 00100 94. CD IT INTERPOLATES FOR THE DESIRED THERMODYNAMIC PROPERTY THER0940
 00100 95. CD AND RETURNS. IF KEY IS SET TO ZERO THE ABOVE IS THER0950
 00100 96. CD PERFORMED. IF KEY IS SET TO NON-ZERO THEN THE SEARCH THER0960
 00100 97. CD FOR THE INDICES IS SKIPPED AND THE VALUES OBTAIN FROM THER0970
 00100 98. CD THE PREVIOUS CALL ARE USED. THIS CAPABILITY ALLOWS THER0980
 00100 99. CD THE USER TO BY PASS REDUDANT CALCULATIONS WHEN THE THER0990
 00100 100. CD INPUT PARAMETERS REMAIN THE SAME BETWEEN SUCESSIVE THER1000
 00100 101. CD CALLS. THER1010
 00100 102. CD THER1020
 00100 103. CD * * * * * THER1030

```

00100 104* C THER1040
00100 105* C THER1050
00100 106* C REFERENCES 1. NBS REPORT 9710A THERMODYNAMIC AND RELATED THER1060
00100 107* C PROPERTIES OF OXYGEN FROM THE TRIPLE POINT THER1070
00100 108* C TO 300 O K AT PRESSURES TO 330 ATMOSPHERES, THER1080
00100 109* C BY L. A. WEBER, 29 AUGUST 1968. THER1090
00100 110* C 2. NBS LETTER ON VISCOSITY AND THERMAL CONDUCTIVITY THER1100
00100 111* C OF OXYGEN, BY H. M. RODER TO J. SMITHSON, NASA/MSC, THER1110
00100 112* C 10 SEPTEMBER 1970. THER1120
00100 113* C THER1130
00101 114* C FUNCTION OPTD (P,T) THER1140
00101 115* C THER1150
00101 116* C
00103 117* C DIMENSION UA(16), UB(83), VB(24)
00103 118* C , U1(83,16), U1(83,16,6), VV(24,16,2)
00103 119* C
00104 120* C COMMON / TPCB / TPCB(9137)
00104 121* C
00105 122* C EQUIVALENCE ( TPCB ( 119 ) , KEY )
00106 123* C EQUIVALENCE ( TPCB ( 120 ) , IDFLAG )
00107 124* C EQUIVALENCE ( TPCB ( 241 ) , UA )
00110 125* C EQUIVALENCE ( TPCB ( 257 ) , UB )
00111 126* C EQUIVALENCE ( TPCB ( 340 ) , UU )
00112 127* C EQUIVALENCE ( TPCB ( 340 ) , U1 )
00113 128* C EQUIVALENCE ( TPCB ( 8320 ) , VB )
00114 129* C EQUIVALENCE ( TPCB ( 8345 ) , VV )
00114 130* C
00115 131* C DATA JMAX / 83 /
00115 132* C THER1270
00117 133* C DATA 16 / 6 / THER1280
00117 134* C THER1290
00117 135* C THIS ROUTINE INTERPOLATES A VALUE FOR DENSITY THER1300
00117 136* C THER1310
00121 137* C IF (P.GT.UA(1).AND.T.LT,UB(JMAX)) GO TO 5
00121 138* C OUT OF RANGE - USE IDEAL GAS EQUATION FOR DENSITY
00123 139* C OPTD = 2.983 * P/T
00124 140* C IERR = 1
00125 141* C WRITE (16,300) P,T,OPTD
00132 142* C RETURN
00132 143* C
00133 144* C 5 CONTINUE
00134 145* C IP = 1 THER1320
00135 146* C GO TO 30 THER1330
00135 147* C THER1340
00135 148* C THIS ROUTINE INTERPOLATES A VALUE FOR THE ISOTHERM DERIVATIVE THER1350
00135 149* C THER1360
00136 150* C ENTRY OPDIT (P,D) THER1370
00140 151* C IP = 2 THER1380
00141 152* C GO TO 20 THER1390
00141 153* C THER1400
00142 154* C ENTRY OPTIT (P,T) THER1410
00142 155* C THER1420
00144 156* C IP = 2 THER1430
00145 157* C GO TO 30 THER1440
00145 158* C THER1450
00145 159* C THIS ROUTINE INTERPOLATES A VALUE FOR THE ISOCHORE DERIVATIVE THER1460
00145 160* C THER1470
00146 161* C ENTRY OPDIC (P,D) THER1480

```

00146 162* C IP = 3
 00150 163* GO TO 20
 00151 164* C
 00151 165* C ENTRY OPTIC (P,T)
 00152 166* C
 00152 167* C IP = 3
 00154 168* GO TO 30
 00155 169* C
 00155 170* C THIS ROUTINE INTERPOLATES A VALUE FOR ENTHALPY
 00155 171* C
 00155 172* C ENTRY OPDH (P,D)
 00156 173* C
 00156 174* C IP = 4
 00160 175* GO TO 20
 00161 176* C
 00161 177* C ENTRY OPTH (P,T)
 00162 178* C
 00162 179* C IP = 4
 00164 180* GO TO 30
 00165 181* C
 00165 182* C THIS ROUTINE INTERPOLATES A VALUE FOR SPECIFIC HEAT
 00165 183* C FOR A CONSTANT VOLUME
 00165 184* C
 00165 185* C ENTRY OPDCV (P,D)
 00166 186* C
 00166 187* C IP = 5
 00170 188* GO TO 20
 00171 189* C
 00171 190* C ENTRY OPTCV (P,T)
 00172 191* IP = 5
 00174 192* GO TO 30
 00175 193* C
 00175 194* C THIS ROUTINE INTERPOLATES A VALUE FOR SPECIFIC HEAT
 00175 195* C FOR A CONSTANT PRESSURE
 00175 196* C
 00175 197* C ENTRY OPDCP (P,D)
 00176 198* C
 00176 199* C IP = 6
 00200 200* GO TO 20
 00201 201* C
 00201 202* C ENTRY OPTCP (P,T)
 00202 203* C
 00202 204* C IP = 6
 00204 205* GO TO 30
 00205 206* C
 00205 207* C THIS ROUTINE INTERPOLATES A VALUE FOR TEMPERATURE
 00205 208* C
 00205 209* C ENTRY OPDT (P,D)
 00206 210* C
 00206 211* C KTYPE = 1
 00210 212* JTYPE = 1
 00211 213* GO TO 40
 00212 214* C
 00212 215* C THIS ROUTINE INTERPOLATES A VALUE FOR VISCOSITY
 00212 216* C
 00212 217* C ENTRY OPTV (P,T)
 00213 218* C
 00213 219* C

THER1490
 THER1500
 THER1510
 THER1520
 THER1530
 THER1540
 THER1550
 THER1560
 THER1570
 THER1580
 THER1590
 THER1600
 THER1610
 THER1620
 THER1630
 THER1640
 THER1650
 THER1660
 THER1670
 THER1680
 THER1690
 THER1700
 THER1710
 THER1720
 THER1730
 THER1740
 THER1750
 THER1760
 THER1770
 THER1780
 THER1790
 THER1800
 THER1810
 THER1820
 THER1830
 THER1840
 THER1850
 THER1860
 THER1870
 THER1880
 THER1890
 THER1900
 THER1910
 THER1920
 THER1930
 THER1940
 THER1950
 THER1960
 THER1970
 THER1980
 THER1990
 THER2000
 THER2010
 THER2020
 THER2030
 THER2040
 THER2050
 THER2060

```

00215 220* 1P = 1 THER2070
00216 221* GO TO 10 THER2080
00216 222* C THER2090
00216 223* C THIS ROUTINE INTERPOLATES A VALUE FOR THERMAL CONDUCTIVITY THER2100
00216 224* C THER2110
00217 225* ENTRY OPTTC (P,T) THER2120
00217 226* C THER2130
00221 227* 1P = 2 THER2140
00222 228* 10 CONTINUE THER2150
00223 229* JTYPE = -1 THER2160
00224 230* KTYPE = -1 THER2170
00225 231* GO TO 40 THER2180
00225 232* C THER2190
00226 233* 20 CONTINUE THER2200
00227 234* KTYPE = 0 THER2210
00230 235* JTYPE = 1 THER2220
00231 236* GO TO 40 THER2230
00231 237* C THER2240
00232 238* 30 CONTINUE THER2250
00233 239* JTYPE = 0 THER2260
00234 240* KTYPE = 0 THER2270
00234 241* C THER2280
00235 242* 40 CONTINUE THER2290
00236 243* IF (KEY.NE.0) GO TO 150 THER2300
00240 244* IERR = 0 THER2310
00240 245* C THER2320
00240 246* C FIND THE PROPER RANGE FOR PRESSURE THER2330
00240 247* C THER2340
00241 248* IF (P.GT.UA(1)) GO TO 50
00241 249* C PRESSURE OUT OF RANGE = LOW
00243 250* P1 = UA(1)
00244 251* K = 1
00245 252* WRITE (16,260) P
00250 253* WRITE (16,290) P1
00253 254* GO TO 70
00253 255* C
00254 256* 50 DO 60 K=1,16
00257 257* IF (UA(K).GT.P) GO TO 69
00261 258* 60 CONTINUE
00261 259* C PRESSURE OUT OF RANGE = HIGH
00263 260* K = K-1
00264 261* P1 = UA(K)
00265 262* WRITE (16,260) P
00270 263* WRITE (16,290) P1
00270 264* C
00273 265* GO TO 70
00274 266* 69 P1 = P
00275 267* 70 A = (P1-UA(K)) / (UA(K)-UA(K-1))
00275 268* C THER2580
00275 269* C THER2590
00275 270* C THER2600
00276 271* IF (JTYPE) 90,100,110 THER2610
00276 272* C THER2620
00276 273* C FIND THE PROPER RANGE FOR TEMPERATURE THER2630
00276 274* C THER2640
00301 275* 90 CONTINUE THER2650
00301 276* C THER2660
00301 277* C VB IS THE TEMPERATURE ARRAY FOR VISCOSITY AND THER2670

```

```

00301 278* C THERMAL CONDUCTIVITY,
00301 279* C
00302 280* IF (T.GT.VB(1)) GO TO 95
00302 281* C TEMPERATURE OUT OF RANGE - LOW
00304 282* T1 = VB(1)
00305 283* WRITE (16,270) T
00310 284* WRITE (16,290) T1
00313 285* GO TO 96
00313 286* C
00314 287* 95 IF (T.LT.VB(24)) GO TO 97
00314 288* C TEMPERATURE OUT OF RANGE - HIGH
00316 289* T1 = VB(24)
00317 290* WRITE (16,270) T
00322 291* WRITE (16,290) T1
00325 292* GO TO 96
00325 293* C
00326 294* 97 T1 = T
00327 295* 96 CALL BINSER (T1,VB,24,JJ,B)
00330 296* GO TO 120
00330 297* C
00331 298* 100 CONTINUE
00332 299* IF (T.GT.UB(1)) GO TO 105
00332 300* C TEMPERATURE OUT OF RANGE - LOW
00334 301* T1 = UB(1)
00335 302* WRITE (16,270) T
00340 303* WRITE (16,290) T1
00343 304* GO TO 106
00343 305* C
00344 306* 105 IF (T.LT.UB(JMAX)) GO TO 107
00344 307* C TEMPERATURE OUT OF RANGE - HIGH
00346 308* T1 = UB(JMAX)
00347 309* WRITE (16,270) T
00352 310* WRITE (16,290) T1
00355 311* GO TO 106
00355 312* C
00356 313* 107 T1 = T
00357 314* 106 CALL BINSER (T1,UB,JMAX,JJ,B)
00360 315* GO TO 120
00360 316* C
00360 317* C
00360 318* C FIND THE PROPER RANGE FOR DENSITY
00360 319* C
00361 320* 110 CONTINUE
00362 321* IF (D.GT.U1(1,K)) GO TO 250
00364 322* IF (D.LT.U1(JMAX,K)) GO TO 245
00366 323* CALL BINSER (D,U1(1,K),JMAX,JJ,B)
00366 324* C
00367 325* IF (X.EQ.1) GO TO 120
00371 326* IF (D.GT.U1(1,K-1)) GO TO 250
00373 327* IF (D.LT.U1(JMAX,K-1)) GO TO 245
00375 328* CALL BINSER (D,U1(1,K-1),JMAX,JK,C)
00376 329* GO TO 130
00376 330* C
00377 331* 120 CONTINUE
00400 332* JK = JJ
00401 333* C = B
00402 334* 130 CONTINUE
00403 335* AC = A*C

```

T 1680
T 1690

THER2800
THER2810
THER2820
THER2830
THER2840

THER2870
THER2880
THER2890

THER2920
THER2930
THER2940
THER2950
THER2960
THER2970
THER2980

00403 336* C THER2990
 00404 337* 140 CONTINUE THER3000
 00405 338* AB = A*B THER3010
 00406 339* 150 CONTINUE THER3020
 00407 340* IF (IERR*EQ.1) GO TO 210 THER3030
 00411 341* IF (KTYPE) 160,170,180 THER3040
 00411 342* C THER3050
 00411 343* C INTERPOLATE AS A FUNCTION OF PRESSURE AND TEMPERATURE THER3060
 00411 344* C THER3070
 00414 345* 160 CONTINUE THER3080
 00415 346* TEMP1 = VV(JJ, K, IP)
 00416 347* TEMP2 = VV(JJ-1, K, IP)
 00417 348* TEMP3 = VV(JJ, K-1, IP)
 00420 349* TEMP4 = VV(JJ-1, K-1, IP)
 00421 350* GO TO 190
 00421 351* C
 00422 352* 170 CONTINUE
 00423 353* TEMP1 = UU(JJ,K,IP)
 00424 354* TEMP2 = UU(JJ-1,K,IP)
 00425 355* TEMP3 = UU(JK,K-1,IP)
 00426 356* TEMP4 = UU(JK-1,K-1,IP)
 00427 357* GO TO 190
 00427 358* C
 00430 359* 180 CONTINUE
 00430 360* C
 00430 361* C INTERPOLATE TEMPERATURE AS A FUNCTION OF PRESSURE AND
 00430 362* C DENSITY
 00430 363* C
 00431 364* TEMP1 = UB(JJ)
 00432 365* TEMP2 = UB(JJ-1)
 00433 366* TEMP3 = UB(JK)
 00434 367* TEMP4 = UB(JK-1)
 00434 368* C
 00435 369* 190 CONTINUE
 00435 370* C
 00435 371* C GENERAL INTERPOLATION BETWEEN PRESSURE AND TEMPERATURE OR
 00435 372* C PRESSURE AND DENSITY
 00435 373* C
 00436 374* TEMP = TEMP1 * (1.+A+U+AB) + TEMP2 * (B+AB) + TEMP3 * (A+AC)
 00436 375* + TEMP4 * AC
 00437 376* GO TO 220
 00437 377* C
 00440 378* 200 CONTINUE
 00441 379* IERR = 1
 00442 380* 210 CONTINUE
 00443 381* TEMP = 0.
 00443 382* C
 00444 383* 220 CONTINUE
 00444 384* C
 00445 385* OPTD = TEMP
 00445 386* C
 00446 387* RETURN
 00446 388* C
 00446 389* C DENSITY IS OUT OF RANGE
 00446 390* C
 00447 391* 245 IDFLAG = 1
 00450 392* 250 WRITE (16,280)D
 00453 393* GO TO 200

THER3640
 THER3650

```

00453 394* C 260 FORMAT (' PRESSURE IS OUT OF RANGE',E15.8) . THER3690
00454 395* 270 FORMAT (' TEMPERATURE IS OUT OF RANGE',E15.8) THER3690
00455 396* 280 FORMAT (' DENSITY IS OUT OF RANGE',E15.8) THER3690
00456 397* 290 FORMAT (' 1H+,T47,12HEVALUATE AT ,E15.8) THER3690
00457 398* 300 FORMAT (' 1H ,46HDENSITY COMPUTED FROM IDEAL GAS EQUATION PTD = ,
00460 400* 1 3E15.8 )
00460 401* C
00461 402* END THER3700
THER3710

```

```

END OF UNIVAC 1108 FORTRAN V COMPILATION. D *DIAGNOSTIC* MESSAGE(S)
THERM SYMBOLIC 02 JUL 71 17:51:21 0 01736746 14 402 (DELETED)
THERM CODE RELOCATABLE 02 JUL 71 17:51:21 1 01751742 72 1 (DELETED)
0 HDG 0 FOR,= TPOCB1,TPOCB1 0 01752052 14 81

```

3.2.55 TPOCB 1

FOR, TPOCB1,TPOCB1
 UNIVAC 1108 FORTRAN V LEVEL 2206 0016 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:21

31 AUG 71

9:28:21.414

BLOCK DATA

STORAGE USED (BLOCK, NAME, LENGTH)

0003 TPCB 021661

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000 I 000000 IS	0000 I 000001 J	0003 R 000000 TPCB	0003 R 000360 UA	0003 R 000400 UB
0003 R 000523 U1	0003 R 003203 U2	0003 R 005663 U3	0003 R 010343 U4	0003 R 013023 U5
0003 R 015503 U6				

207

00100	1*	CD	*****	TP010010
00100	2*	CD		TP010020
00100	3*	CD		TP010030
00100	4*	CD	PROGRAMMER AND DATE	TP010040
00100	5*	CD	J. I. PREWITT	TP010050
00100	6*	CD	DECEMBER 1970	TP010060
00100	7*	CD		TP010070
00100	8*	CD	PURPOSE	TP010080
00100	9*	CD	INITIALIZATION OF WEBER'S THERMODYNAMIC PROPERTIES OF	TP010090
00100	10*	CD	OXYGEN.	TP010100
00100	11*	CD		TP010110
00100	12*	CD	USAGE	TP010120
00100	13*	CD	BLOCK DATA	TP010130
00100	14*	CD		TP010140
00100	15*	CD	DESCRIPTION OF PARAMETERS	TP010150
00100	16*	CD		TP010160
00100	17*	CD	INPUT	TP010170
00100	18*	CD	NONE	TP010180
00100	19*	CD		TP010190
00100	20*	CD		TP010200
00100	21*	CD	OUTPUT	TP010210
00100	22*	CD	CALLING SEQUENCE	TP010220
00100	23*	CD	NONE	TP010230
00100	24*	CD	COMMON	TP010240
00100	25*	CD	UA - PRESSURE ARRAY	TP010250
00100	26*	CD	UB - TEMPERATURE ARRAY	TP010260
00100	27*	CD	U1 - DENSITY ARRAY	TP010270
00100	28*	CD	U2 - ISOTHERM DERIVATIVE ARRAY	TP010280
00100	29*	CD	U3 - ISOCORE DERIVATIVE ARRAY	TP010290
00100	30*	CD	U4 - ENTHALPHY ARRAY	TP010300
00100	31*	CD	U5 - SPECIFIC HEAT FOR CONSTANT VOLUME	TP010310
00100	32*	CD	U6 - SPECIFIC HEAT FOR CONSTANT PRESSURE	TP010320
00100	33*	CD		TP010330
00100	34*	CD	REMARKS AND RESTRICTIONS	TP010340
00100	35*	CD	THIS BLOCK DATA ROUTINE IS INITIALIZED EVERY TIME THE	TP010350
00100	36*	CD	SUBPROGAM THERM IS LOADED INTO CORE.	TP010360

00100 37* CD TP010700
 00100 38* CD SUBPROGRAMS TPO10700
 00100 39* CD NONE TP010700
 00100 40* CD TP010400
 00100 41* CD METHOD TP010410
 00100 42* CD REFERENCE TP010420
 00100 43* CD NBS REPORT 9710A, THERMODYNAMIC AND RELATED TP010430
 00100 44* CD PROPERTIES OF OXYGEN FROM THE TRIPLE POINT TP010440
 00100 45* CD TO 300.0 K AT PRESSURES TO 300 ATMOSPHERES, TP010450
 00100 46* CD BY L. A. WEBER, 29 AUGUST 1968. TP010460
 00100 47* CD TP010470
 00100 48* CD TP010480
 00101 49* BLOCK DATA TP010490
 00101 50* C TP010500
 00102 51* DIMENSION UA(16), UB(83)
 00103 52* DIMENSION U1(83,16), U2(83,16), U3(83,16)
 00103 53* U4(83,16), U5(83,16), U6(83,16)
 00103 54* C
 00104 55* COMMON / TPCB / TPCB(9137)
 00104 56* C
 00105 57* EQUIVALENCE (TPCB(241) , UA)
 00106 58* EQUIVALENCE (TPCB(257) , UB)
 00107 59* EQUIVALENCE (TPCB(340) , U1)
 00110 60* EQUIVALENCE (TPCB(1668) , U2)
 00111 61* EQUIVALENCE (TPCB(2996) , U3)
 00112 62* EQUIVALENCE (TPCB(4324) , U4)
 00113 63* EQUIVALENCE (TPCB(5652) , U5)
 00114 64* EQUIVALENCE (TPCB(6980) , U6)
 00114 65* C TP010620
 00114 66* C TP010630
 00114 67* C TP010640
 00114 68* C TP010650
 00114 69* C TEMPERATURE RANGE FOR DENSITY, ISOTHERM DERIVATIVE, TP010660
 00114 70* C ISOCHORE DERIVATIVE, ENTHALPHY, SPECIFIC HEAT FOR TP010670
 00114 71* C CONSTANT VOLUME AND CONSTANT PRESSURE TP010680
 00114 72* C TP010690
 00115 73* DATA UB / TP010700
 00115 74* * 100.00000, 105.00000, 110.00000, 115.00000, 120.00000, TP010710
 00115 75* * 125.00000, 130.00000, 135.00000, 140.00000, 145.00000, TP010720
 00115 76* * 150., 155., 160., 0210504513615, 0210504513616, 165., 170.,
 00115 77* * 175.00000, 180.00000, 185.00000, 190.00000, 195.00000, TP010740
 00115 78* * 200.00000, 205.00000, 210.00000, 215.00000, 220.00000, TP010750
 00115 79* * 225., 0210712065176, 0210712065177, 230., 235.,
 00115 80* * 0210736722743, 0210736722743, 240., 245.,
 00115 81* * 0210760202030, 0210760202031, 250.00000, 255.00000,
 00115 82* * 0210777172702, 0210777172703, 260.00000, 0211406173716,
 00115 83* * 0211406173717, 265.00000, 0211414134530,
 00115 84* * 0211414134531, 270., 0211421435544, 0211421435545, 275., TP010780
 00115 85* * 0211424350754, 0211424350755, 280., 285.00, 290.00000, TP010790
 00115 86* * 295.00000, 300.00000, 310.00000, 320.00000, 330.00000, TP010800
 00115 87* * 340.00000, 350.00000, 360.00000, 370.00000, 380.00000, TP010810
 00115 88* * 390.00000, 400.00000, 410.00000, 420.00000, 430.00000, TP010820
 00115 89* * 440.00000, 450.00000, 460.00000, 470.00000, 480.00000, TP010830
 00115 90* * 490.00000, 500.00000, 510.00000, 520.00000, 530.00000, TP010840
 00115 91* * 540.00000/ TP010850
 00115 92* C TP010860
 00115 93* C TP010870
 00115 94* C

209

```

00115 950 C
00115 960 C PRESSURE - PSIA
00115 970 C
00117 980 DATA UA(1) / 14.696 /
00117 990 C
00117 1000 C DENSITY - LB/CU FT - FOR 14.696 PSIA
00117 1010 C
00121 1020 DATA (U1(J, 1),J=1,83) /
00121 1030 * 81.23477, 80.45052, 79.68127, 78.92660, 78.18608,
00121 1040 * 77.39938, 76.56968, 75.75758, 74.96252, 74.12898,
00121 1050 * 73.31378, 72.46377, 71.63324, 71.22507, 27938,
00121 1060 * 27439, 26555, 25732, 24961, 24238,
00121 1070 * 23558, 22918, 22313, 21740, 21197,
00121 1080 * 20682, 20193, 19726, 19673, 19673,
00121 1090 * 19282, 18858, 18495, 18495, 18452,
00121 1100 * 18064, 17830, 17830, 17692, 17336,
00121 1110 * 17293, 17293, 16994, 16845, 16845,
00121 1120 * 16666, 16464, 16464, 16350, 16133,
00121 1130 * 16133, 16047, 15843, 15843, 15754,
00121 1140 * 15472, 15201, 14938, 14685, 14204,
00121 1150 * 13754, 13332, 12935, 12561, 12209,
00121 1160 * 11876, 11561, 11262, 10978, 10708,
00121 1170 * 10452, 10207, 09974, 09751, 09538,
00121 1180 * 09334, 09139, 08951, 08772, 08599,
00121 1190 * 08433, 08273, 08120/
00121 1200 C
00121 1210 C ISOTHERM DERIVATIVE - ALL VALUES SET TO ZERO
00121 1220 C
00123 1230 DATA (U2(J, 1),J=1,83) / 83.00 /
00123 1240 C
00123 1250 C ISOCHORE DERIVATIVE - ALL VALUES SET TO ZERO
00123 1260 C
00125 1270 DATA (U3(J, 1),J=1,83) / 83.00 /
00125 1280 C
00125 1290 C ENTHALPY - BTU/LB - FOR 14.696 PSIA
00125 1300 C
00127 1310 DATA (U4(J,1),J=1,83) /
00127 1320 * -82.272, -80.285, -78.298, -76.310, -74.321,
00127 1330 * -72.332, -70.341, -68.347, -66.350, -64.350,
00127 1340 * -62.344, -60.333, -58.315, -57.374, 34.153,
00127 1350 * 34.767, 35.909, 37.046, 38.179, 39.307,
00127 1360 * 40.432, 41.554, 42.673, 43.790, 44.904,
00127 1370 * 46.017, 47.128, 48.237, 49.134, 49.134,
00127 1380 * 49.344, 50.451, 51.436, 51.436, 51.556,
00127 1390 * 52.660, 53.349, 53.349, 53.762, 54.864,
00127 1400 * 55.000, 55.000, 55.965, 56.459, 56.459,
00127 1410 * 57.066, 57.765, 57.765, 58.165, 58.947,
00127 1420 * 58.947, 59.264, 60.023, 60.023, 60.362,
00127 1430 * 61.460, 62.557, 63.654, 64.750, 66.941,
00127 1440 * 69.130, 71.318, 73.505, 75.691, 77.877,
00127 1450 * 80.062, 82.246, 84.430, 86.614, 88.798,
00127 1460 * 90.982, 93.166, 95.351, 97.536, 99.722,
00127 1470 * 101.909, 104.096, 106.285, 108.475, 110.666,
00127 1480 * 112.859, 115.053, 117.249 /
00127 1490 C
00127 1500 C SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 14.696 PSIA
00127 1510 C
00131 1520 DATA (U5(J,1),J=1,83) /

```

00131	153*	0.264	0.260,	0.256,	0.252,	0.248,
00131	154*	0.244	0.241,	0.237,	0.234,	0.231,
00131	155*	0.228	0.225,	0.222,	0.221,	0.159,
00131	156*	0.159,	0.158,	0.158,	0.158,	0.158,
00131	157*	0.157,	0.157,	0.157,	0.157,	0.157,
00131	158*	0.157,	0.157,	0.156,	0.156,	0.156,
00131	159*	0.156,	0.156,	0.156,	0.156,	0.156,
00131	160*	0.156,	0.156,	0.156,	0.156,	0.156,
00131	161*	0.156,	0.156,	0.156,	0.156,	0.156,
00131	162*	0.156,	0.156,	0.156,	0.156,	0.156,
00131	163*	0.156,	0.156,	0.156,	0.156,	0.156,
00131	164*	0.156,	0.156,	0.156,	0.156,	0.156,
00131	165*	0.156,	0.156,	0.156,	0.156,	0.156,
00131	166*	0.156,	0.156,	0.156,	0.156,	0.156,
00131	167*	0.156,	0.156,	0.156,	0.156,	0.156,
00131	168*	0.156,	0.156,	0.156,	0.157,	0.157,
00131	169*	0.157,	0.157,	0.157,		

```

00131      170*   C
00131      171*   C      SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM O R -      14.696 PSIA

```

DATA (U6(J,1),J=1,83)	/				
00133 172*	°	0.398,	0.397,	0.397,	0.398,
00133 173*	°	0.398,	0.398,	0.399,	0.400,
00133 174*	°	0.402,	0.403,	0.404,	0.405,
00133 175*	°	0.229,	0.228,	0.227,	0.226,
00133 176*	°	0.225,	0.224,	0.224,	0.223,
00133 178*	°	0.222,	0.222,	0.222,	0.221,
00133 179*	°	0.221,	0.221,	0.221,	0.221,
00133 180*	°	0.221,	0.221,	0.221,	0.220,
00133 181*	°	0.220,	0.220,	0.220,	0.220,
00133 182*	°	0.220,	0.220,	0.220,	0.220,
00133 183*	°	0.220,	0.220,	0.220,	0.220,
00133 184*	°	0.219,	0.219,	0.219,	0.219,
00133 185*	°	0.219,	0.219,	0.219,	0.219,
00133 186*	°	0.218,	0.218,	0.218,	0.218,
00133 187*	°	0.218,	0.218,	0.218,	0.219,
00133 188*	°	0.219,	0.219,	0.219,	0.219,
00133 189*	°	0.219,	0.220,	0.220/	

```

00133 190* C
00133 191* C*****
00133 192* C      PRESSURE = PSIA

```

```

00113 193* C
00135 194* DATA UA(2) / 220.440 /
00135 195* C
00135 196* C DENSITY - LB/CU FT - FOR 220.440 PSIA

```

DATA (U11J, 21, J=1,83) /
00137 198° * 81.36696, 80.58118, 79.80846, 79.05138, 78.30853,
00137 199° * 77.51938, 76.68712, 75.93014, 75.13148, 74.29420,
00137 200° * 73.47538, 72.67442, 71.83908, 71.47963, 71.47963,
00137 201° * 70.97232, 70.07708, 69.20415, 68.30601, 67.38544,
00137 202° * 66.44518, 65.48788, 64.47453, 63.41154, 62.34414,
00137 203° * 61.19951, 60.02401, 58.75441, 57.67013, 3.68881,
00137 204° * 3.65591, 3.49711, 3.37302, 3.37302, 3.35841,
00137 205° * 3.23530, 3.16526, 3.16526, 3.12471, 3.02435,
00137 206° * 3.01268, 3.01268, 2.93255, 2.89402, 2.89402,
00137 207° * 2.84795, 2.79754, 2.79759, 2.76962, 2.71739,
00137 208° * 2.71739, 2.64936, 2.64936, 2.64936, 2.62867,
00137 209° * 2.56476, 2.50470, 2.44798, 2.39435, 2.29516,

00137 211° * 2.20527, 2.12323, 2.04801, 1.97859, 1.91435,
 00137 212° * 1.85460, 1.79885, 1.74669, 1.69774, 1.65169,
 00137 213° * 1.60829, 1.56725, 1.52842, 1.49160, 1.45662,
 00137 214° * 1.42335, 1.39163, 1.36138, 1.33248, 1.30484,
 00137 215° * 1.27838, 1.25301, 1.22867/

00137 216° C
 00137 217° C ISOTHERM DERIVATIVE - ALL VALUES SET TO ZERO
 00137 218° C

00141 219° DATA (U2(J, 2),J=1,83) / 83*0. /
 00141 220° C

00141 221° C ISOCORE DERIVATIVE - ALL VALUES SET TO ZERO
 00141 222° C

00143 223° DATA (U3(J, 2),J=1,83) / 83*0. /
 00143 224° C

00143 225° C ENTHALPY - BTU/LB - FOR 220.440 PSIA
 00143 226° C

00145 227° DATA (U4(J,2),J=1,83) /
 00145 228° * -81.892, -79.906, -77.921, -75.936, -73.951,
 00145 229° * -71.965, -69.977, -67.988, -65.996, -64.001,
 00145 230° * -62.001, -59.997, -57.986, -57.048, -57.048,
 00145 231° * -55.968, -53.942, -51.905, -49.856, -47.792,
 00145 232° * -45.711, -43.609, -41.483, -39.328, -37.138,
 00145 233° * -34.906, -32.621, -30.271, -28.306, 40.081,
 00145 234° * 40.414, 42.109, 43.545, 43.545, 43.720,
 00145 235° * 45.267, 46.201, 46.201, 46.762, 48.215,
 00145 236° * 48.391, 48.391, 49.632, 50.254, 50.254,
 00145 237° * 51.019, 51.886, 51.886, 52.381, 53.334,
 00145 238° * 53.334, 53.721, 54.633, 54.633, 55.041,
 00145 239° * 56.344, 57.632, 58.907, 60.170, 62.664,
 00145 240° * 65.123, 67.552, 69.955, 72.337, 74.701,
 00145 241° * 77.048, 79.382, 81.703, 84.014, 86.315,
 00145 242° * 88.609, 90.894, 93.174, 95.448, 97.716,
 00145 243° * 99.981, 102.242, 104.500, 106.755, 109.008,
 00145 244° * 111.259, 113.509, 115.758/

00145 245° C
 00145 246° C SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 220.440 PSIA
 00145 247° C

00147 248° DATA (U5(J,2),J=1,83) /
 00147 249° * 0.264, 0.260, 0.256, 0.252, 0.248,
 00147 250° * 0.244, 0.241, 0.238, 0.235, 0.231,
 00147 251° * 0.229, 0.226, 0.223, 0.222, 0.222,
 00147 252° * 0.221, 0.218, 0.216, 0.213, 0.211,
 00147 253° * 0.209, 0.207, 0.205, 0.203, 0.201,
 00147 254° * 0.200, 0.198, 0.197, 0.195, 0.185,
 00147 255° * 0.185, 0.181, 0.178, 0.178, 0.178,
 00147 256° * 0.175, 0.173, 0.173, 0.173, 0.172,
 00147 257° * 0.172, 0.172, 0.170, 0.169, 0.169,
 00147 258° * 0.169, 0.168, 0.168, 0.168, 0.167,
 00147 259° * 0.167, 0.167, 0.166, 0.166, 0.166,
 00147 260° * 0.165, 0.164, 0.163, 0.163, 0.162,
 00147 261° * 0.161, 0.160, 0.160, 0.159, 0.159,
 00147 262° * 0.159, 0.158, 0.158, 0.158, 0.158,
 00147 263° * 0.158, 0.158, 0.157, 0.157, 0.157,
 00147 264° * 0.157, 0.157, 0.157, 0.157, 0.158,
 00147 265° * 0.158, 0.158, 0.158/

00147 266° C
 00147 267° C SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM O R - 220.440 PSIA
 00147 268° C

```

00151 269* DATA (U6(J,2),J=1,83) /
00151 270* * 0.397, 0.397, 0.397, 0.397, 0.397,
00151 271* * 0.397, 0.398, 0.398, 0.399, 0.399,
00151 272* * 0.400, 0.401, 0.403, 0.403, 0.403,
00151 273* * 0.404, 0.406, 0.409, 0.411, 0.414,
00151 274* * 0.418, 0.423, 0.428, 0.434, 0.442,
00151 275* * 0.451, 0.463, 0.477, 0.492, 0.533,
00151 276* * 0.549, 0.530, 0.517, 0.517, 0.515,
00151 277* * 0.504, 0.528, 0.528, 0.529, 0.527,
00151 278* * 0.526, 0.526, 0.520, 0.528, 0.528,
00151 279* * 0.525, 0.522, 0.522, 0.520, 0.527,
00151 280* * 0.527, 0.526, 0.523, 0.523, 0.522,
00151 281* * 0.529, 0.526, 0.524, 0.521, 0.524,
00151 282* * 0.524, 0.522, 0.523, 0.523, 0.523,
00151 283* * 0.524, 0.523, 0.522, 0.521, 0.520,
00151 284* * 0.522, 0.522, 0.522, 0.522, 0.522,
00151 285* * 0.522, 0.522, 0.522, 0.522, 0.522,
00151 286* * 0.522, 0.522, 0.522, 0.522, 0.522,
00151 287* C
00151 288* C*****
00151 289* C PRESSURE - PSIA
00151 290* C
00153 291* DATA UA(3) / 293.920 /
00153 292* C
00153 293* C DENSITY - LB/CU FT - FOR 293.920 PSIA
00153 294* C
00155 295* DATA (U1(J,3),J=1,83) /
00155 296* * 81.36696, 80.64516, 79.87220, 79.11392, 78.30853,
00155 297* * 77.51938, 76.74597, 75.98784, 75.18797, 74.34944,
00155 298* * 73.52941, 72.72727, 71.89073, 71.53076, 71.53076,
00155 299* * 71.02273, 70.17544, 69.30007, 68.39945, 67.47638,
00155 300* * 66.53360, 65.57377, 64.59948, 63.57279, 62.50000,
00155 301* * 61.38735, 60.20470, 58.96226, 57.90388, 57.90388,
00155 302* * 57.63689, 56.21135, 54.82456, 5.02563, 4.99476,
00155 303* * 4.74046, 4.60405, 4.60405, 4.52591, 4.34047,
00155 304* * 4.31947, 4.31947, 4.17728, 4.11049, 4.11049,
00155 305* * 4.03128, 3.94649, 3.94649, 3.89955, 3.84438,
00155 306* * 3.84438, 3.77958, 3.70274, 3.70274, 3.66946,
00155 307* * 3.56773, 3.47331, 3.38535, 3.30284, 3.15259,
00155 308* * 3.01832, 2.89746, 2.78769, 2.68738, 2.59518,
00155 309* * 2.51004, 2.43108, 2.35760, 2.28891, 2.22460,
00155 310* * 2.16413, 2.10722, 2.05351, 2.00268, 1.95454,
00155 311* * 1.90840, 1.86532, 1.82395, 1.78447, 1.74676,
00155 312* * 1.71072, 1.67622, 1.64314/
00155 313* C
00155 314* C ISOTHERM DERIVATIVE - ALL VALUES SET TO ZERO
00155 315* C
00157 316* DATA (U2(J,3),J=1,83) / 83.00 /
00157 317* C
00157 318* C ISOCHORE DERIVATIVE - ALL VALUES SET TO ZERO
00157 319* C
00161 320* DATA (U3(J,3),J=1,83) / 83.00 /
00161 321* C
00161 322* C ENTHALPY - BTU/LB - FOR 293.920 PSIA
00161 323* C
00163 324* DATA (U4(J,3),J=1,83) /
00163 325* * -81.756, -79.771, -77.787, -75.803, -73.819,
00163 326* * -71.834, -69.848, -67.860, -65.869, -63.876,

```

00163	327*	*	-61.878,	-59.876,	-57.868,	-56.931,	-56.931,
00163	328*	*	-55.853,	-53.830,	-51.797,	-49.752,	-47.693,
00163	329*	*	-45.618,	-43.523,	-41.405,	-39.260,	-37.082,
00163	330*	*	-34.863,	-32.596,	-30.268,	-28.319,	-26.319,
00163	331*	*	-27.864,	-25.340,	-22.986,	39.526,	39.749,
00163	332*	*	41.699,	42.832,	42.832,	43.511,	45.221,
00163	333*	*	45.423,	45.423,	46.854,	47.558,	47.558,
00163	334*	*	48.424,	49.390,	49.390,	49.943,	50.995,
00163	335*	*	50.995,	51.421,	52.417,	52.417,	52.863,
00163	336*	*	54.276,	55.662,	57.026,	58.370,	61.007,
00163	337*	*	63.587,	66.122,	68.619,	71.083,	73.520,
00163	338*	*	75.934,	78.328,	80.704,	83.064,	85.412,
00163	339*	*	87.747,	90.072,	92.387,	94.695,	96.995,
00163	340*	*	99.289,	101.577,	103.861,	106.140,	108.416,
00163	341*	*	110.689,	112.959,	115.227,		

C

C

C

SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 293.920 PSIA

DATA (U6(J,3),J=1,83) /

00165	345*	*	0.265,	0.260,	0.256,	0.252,	0.248,
00165	346*	*	0.245,	0.241,	0.238,	0.235,	0.232,
00165	347*	*	0.229,	0.226,	0.223,	0.222,	0.222,
00165	348*	*	0.221,	0.218,	0.216,	0.214,	0.211,
00165	349*	*	0.209,	0.207,	0.205,	0.203,	0.202,
00165	350*	*	0.200,	0.198,	0.197,	0.195,	0.195,
00165	351*	*	0.195,	0.193,	0.192,	0.191,	0.190,
00165	352*	*	0.187,	0.187,	0.187,	0.183,	0.180,
00165	353*	*	0.179,	0.179,	0.177,	0.176,	0.176,
00165	354*	*	0.175,	0.174,	0.174,	0.173,	0.172,
00165	355*	*	0.172,	0.171,	0.170,	0.170,	0.170,
00165	356*	*	0.169,	0.168,	0.167,	0.166,	0.164,
00165	357*	*	0.163,	0.162,	0.162,	0.161,	0.160,
00165	358*	*	0.160,	0.159,	0.159,	0.159,	0.158,
00165	359*	*	0.158,	0.158,	0.158,	0.158,	0.158,
00165	360*	*	0.158,	0.158,	0.158,	0.158,	0.158,
00165	361*	*	0.158,	0.158,	0.158,	0.158,	0.158,
00165	362*	*	0.158,	0.158,	0.158,	0.158,	0.158,

C

C

C

SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM O R - 293.920 PSIA

DATA (U6(J,3),J=1,83) /

00167	366*	*	0.397,	0.397,	0.397,	0.397,	0.397,
00167	367*	*	0.397,	0.397,	0.398,	0.398,	0.399,
00167	368*	*	0.400,	0.401,	0.402,	0.403,	0.403,
00167	369*	*	0.404,	0.406,	0.408,	0.410,	0.413,
00167	370*	*	0.417,	0.421,	0.426,	0.432,	0.439,
00167	371*	*	0.448,	0.459,	0.472,	0.485,	0.485,
00167	372*	*	0.489,	0.519,	0.545,	0.412,	0.407,
00167	373*	*	0.375,	0.360,	0.360,	0.351,	0.334,
00167	374*	*	0.332,	0.332,	0.320,	0.315,	0.315,
00167	375*	*	0.309,	0.302,	0.302,	0.299,	0.294,
00167	376*	*	0.294,	0.292,	0.287,	0.287,	0.285,
00167	377*	*	0.280,	0.275,	0.271,	0.267,	0.261,
00167	378*	*	0.256,	0.251,	0.248,	0.245,	0.242,
00167	379*	*	0.240,	0.238,	0.237,	0.235,	0.234,
00167	380*	*	0.233,	0.232,	0.231,	0.230,	0.230,
00167	381*	*	0.229,	0.229,	0.229,	0.228,	0.227,
00167	382*	*	0.227,	0.227,	0.227,	0.227,	0.227,
00167	383*	*	0.227,	0.227,	0.227,	0.227,	0.227,
00167	384*	*	0.227,	0.227,	0.227,	0.227,	0.227,

C

```

00167 385* C*****
00167 386* C PRESSURE PSIA
00167 387* C
00171 388* DATA UA(4) / 367.400 /
00171 389* C
00171 390* C DENSITY - LB/CU FT - FOR 367.400 PSIA
00171 391* C
00173 392* DATA (U1(J, 4),J=1,83) /
00173 393* * 81.43322, 80.64516, 79.87220, 79.11392, 78.36991,
00173 394* * 77.57952, 76.80491, 76.04563, 75.24454, 74.40476,
00173 395* * 73.63770, 72.78020, 71.94245, 71.56192, 71.56192,
00173 396* * 71.12375, 70.27407, 69.39625, 68.49315, 67.56757,
00173 397* * 66.66667, 65.70302, 64.72492, 63.69427, 62.61741,
00173 398* * 61.53846, 60.38647, 59.17160, 58.11708, 58.11708,
00173 399* * 57.87037, 56.46527, 55.13737, 55.13737, 54.97526,
00173 400* * 53.27650, 52.11047, 6.48971, 6.32831, 5.96338,
00173 401* * 5.92487, 5.92487, 5.66572, 5.55001, 5.55001,
00173 402* * 5.41389, 5.27315, 5.27315, 5.19588, 5.05740,
00173 403* * 5.05740, 5.00350, 4.88329, 4.88329, 4.83138,
00173 404* * 4.67574, 4.53412, 4.40393, 4.28357, 4.06785,
00173 405* * 3.87883, 3.71085, 3.56024, 3.42395, 3.29979,
00173 406* * 3.19091, 3.08090, 2.98374, 2.89335, 2.80907,
00173 407* * 2.73015, 2.65611, 2.58645, 2.52073, 2.45857,
00173 408* * 2.39969, 2.34384, 2.29079, 2.24024, 2.19202,
00173 409* * 2.14601, 2.10203, 2.05994/
00173 410* C
00173 411* C ISOTHERM DERIVATIVE - ALL VALUES SET TO ZERO
00173 412* C
00175 413* DATA (U2(J, 4),J=1,83) / 83.0. /
00175 414* C
00175 415* C ISOCHORE DERIVATIVE - ALL VALUES SET TO ZERO
00175 416* C
00177 417* DATA (U3(J, 4),J=1,83) / 83.0. /
00177 418* C
00177 419* C ENTHALPY - BTU/LB - FOR 367.400 PSIA
00177 420* C
00201 421* DATA (U4(J, 4),J=1,83) /
00201 422* * -81.619, -79.636, -77.653, -75.670, -73.686,
00201 423* * -71.702, -69.718, -67.731, -65.742, -63.751,
00201 424* * -61.755, -59.755, -57.750, -56.815, -56.815,
00201 425* * -55.738, -53.718, -51.683, -49.648, -47.594,
00201 426* * -45.524, -43.436, -41.326, -39.190, -37.022,
00201 427* * -34.817, -32.567, -30.260, -28.334, -28.334,
00201 428* * -27.883, -25.392, -23.078, -23.078, -22.796,
00201 429* * -20.040, -18.209, 38.508, 39.402, 41.597,
00201 430* * 41.797, 41.797, 43.592, 43.792, 43.792,
00201 431* * 43.447, 45.561, 46.561, 47.199, 47.399,
00201 432* * 47.399, 48.870, 49.980, 49.980, 50.477,
00201 433* * 52.033, 53.543, 55.017, 56.459, 59.266,
00201 434* * 61.988, 64.642, 67.242, 69.797, 72.314,
00201 435* * 74.799, 77.257, 79.691, 82.104, 84.499,
00201 436* * 86.879, 89.244, 91.597, 93.939, 96.272,
00201 437* * 98.596, 100.912, 103.222, 105.526, 107.825,
00201 438* * 110.119, 112.410, 114.697/
00201 439* C
00201 440* C SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 367.400 PSIA
00201 441* C
00203 442* DATA (U5(J, 4),J=1,83)

```

00203	443*	°	.265,	.260,	.256,	.252,	.248,
00203	444*	°	.245,	.241,	.238,	.235,	.232,
00203	445*	°	.229,	.226,	.224,	.223,	.223,
00203	446*	°	.221,	.219,	.216,	.214,	.212,
00203	447*	°	.210,	.208,	.206,	.204,	.202,
00203	448*	°	.200,	.198,	.197,	.195,	.195,
00203	449*	°	.195,	.198,	.197,	.197,	.197,
00203	450*	°	.196,	.196,	.201,	.198,	.191,
00203	451*	°	.190,	.190,	.187,	.185,	.185,
00203	452*	°	.183,	.181,	.181,	.180,	.178,
00203	453*	°	.178,	.177,	.176,	.176,	.175,
00203	454*	°	.173,	.172,	.170,	.169,	.167,
00203	455*	°	.165,	.164,	.163,	.162,	.162,
00203	456*	°	.161,	.160,	.160,	.160,	.159,
00203	457*	°	.159,	.159,	.159,	.158,	.158,
00203	458*	°	.158,	.158,	.158,	.158,	.158,
00203	459*	°	.158,	.158,	.158/		

00203 460* C
00203 461* C
00203 462* C

SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM O R - 367.400 PSIA

00205 463*		DATA (U6(J, 4),J=1,83) /					
00205	464*	°	.397,	.397,	.397,	.397,	.397,
00205	465*	°	.397,	.397,	.397,	.398,	.399,
00205	466*	°	.399,	.400,	.402,	.402,	.402,
00205	467*	°	.403,	.405,	.407,	.409,	.412,
00205	468*	°	.416,	.420,	.424,	.430,	.437,
00205	469*	°	.445,	.455,	.467,	.561,	.561,
00205	470*	°	.583,	.509,	.529,	.529,	.532,
00205	471*	°	.571,	.603,	.490,	.465,	.416,
00205	472*	°	.412,	.412,	.384,	.373,	.373,
00205	473*	°	.360,	.349,	.349,	.342,	.331,
00205	474*	°	.331,	.327,	.319,	.319,	.316,
00205	475*	°	.306,	.298,	.292,	.286,	.276,
00205	476*	°	.279,	.263,	.258,	.253,	.250,
00205	477*	°	.247,	.245,	.242,	.240,	.239,
00205	478*	°	.237,	.236,	.235,	.234,	.233,
00205	479*	°	.232,	.231,	.231,	.230,	.230,
00205	480*	°	.229,	.229,	.229/		

00205 481* C

C*****

00205 482* C

00205 483* C

00205 484* C

PRESSURE - PSIA

00205 485* C

00207 486*

DATA UA(5) / 440.880 /

00207 487* C

00207 488* C

DENSITY - LB/CU FT - FOR 440.880 PSIA

00207 489* C

00211 490*		DATA (U1(J, 5),J=1,83) /					
00211	491*	°	81.43322,	80.71025,	79.93605,	79.17656,	78.43137,
00211	492*	°	77.63975,	76.86395,	76.04563,	75.30120,	74.46016,
00211	493*	°	73.69197,	72.83321,	72.04611,	71.64093,	71.64093,
00211	494*	°	71.17438,	70.32349,	69.44444,	68.96552,	67.65900,
00211	495*	°	66.75567,	65.78947,	64.80881,	63.81621,	62.77464,
00211	496*	°	61.69031,	60.56935,	59.38242,	58.34781,	58.34781,
00211	497*	°	58.10575,	56.75369,	55.46683,	55.46683,	55.30973,
00211	498*	°	53.67686,	52.52101,	52.52101,	51.92108,	49.70179,
00211	499*	°	49.40711,	8.13387,	7.58956,	7.37786,	7.37786,
00211	500*	°	7.11744,	6.87783,	6.87783,	6.74082,	6.51702,

00211	501*	°	6.51702,	6.42632,	6.24014,	6.24014,	6.15688,
00211	502*	°	5.92101,	5.81135,	5.52303,	5.35160,	5.05102,
00211	503*	°	4.79294,	4.67888,	4.36872,	4.19041,	4.02950,
00211	504*	°	3.88304,	3.74897,	3.62555,	3.51148,	3.40541,
00211	505*	°	3.30655,	3.21409,	3.12735,	3.04572,	2.96877,
00211	506*	°	2.89603,	2.82717,	2.76182,	2.69971,	2.65463,
00211	507*	°	2.56418,	2.53036,	2.47893,		

00211	508*	C	
00211	509*	C	ISOTHERM DERIVATIVE - ALL VALUES SET TO ZERO

00211	510*	C	
00213	511*		DATA (U2(J, 5), J=1, 83) / 83*0. /

00213	512*	C	
00213	513*	C	ISOCHORE DERIVATIVE - ALL VALUES SET TO ZERO

00213	514*	C	
00215	515*		DATA (U3(J, 5), J=1, 83) / 83*0. /

00215	516*	C	
00215	517*	C	ENTHALPY - BTU/LB - FOR 440.880 PSIA

00215	518*	C	
00217	519*		DATA (U4(J, 5), J=1, 83) /
00217	520*	°	-81.483, -79.500, -77.513, -75.536, -73.554,
00217	521*	°	-71.571, -69.587, -67.602, -65.615, -63.625,
00217	522*	°	-61.632, -59.634, -57.631, -56.697, -56.697,
00217	523*	°	-55.622, -53.605, -51.579, -49.543, -47.494,
00217	524*	°	-45.429, -43.348, -41.245, -39.117, -36.961,
00217	525*	°	-34.768, -32.533, -30.246, -28.339, -28.339,
00217	526*	°	-27.893, -25.434, -23.090, -23.090, -22.804,
00217	527*	°	-20.192, -18.395, -18.395, -17.313, -14.134,
00217	528*	°	-13.709, 27.050, 39.477, 39.677, 39.677,
00217	529*	°	41.565, 43.115, 43.115, 44.002, 44.202,
00217	530*	°	44.202, 45.968, 47.242, 47.242, 47.812,
00217	531*	°	49.562, 51.237, 52.852, 54.418, 57.429,
00217	532*	°	60.316, 63.107, 65.882, 68.447, 71.081,
00217	533*	°	73.643, 76.169, 78.664, 81.132, 83.578,
00217	534*	°	86.003, 88.411, 90.803, 93.181, 95.546,
00217	535*	°	97.001, 100.246, 102.503, 104.912, 107.234,
00217	536*	°	109.551, 111.862, 114.169,

00217	537*	C	
00217	538*	C	SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 440.880 PSIA

00217	539*	C	
00221	540*		DATA (U5(J, 5), J=1, 83) /
00221	541*	°	.265, .260, .256, .252, .249,
00221	542*	°	.245, .242, .238, .235, .232,
00221	543*	°	.229, .226, .224, .223, .223,
00221	544*	°	.221, .219, .216, .214, .212,
00221	545*	°	.210, .208, .206, .204, .202,
00221	546*	°	.200, .198, .197, .195, .195,
00221	547*	°	.195, .193, .197, .197, .197,
00221	548*	°	.196, .196, .196, .196, .198,
00221	549*	°	.198, .200, .200, .197, .197,
00221	550*	°	.193, .190, .190, .188, .185,
00221	551*	°	.185, .184, .182, .182, .181,
00221	552*	°	.178, .176, .174, .172, .170,
00221	553*	°	.169, .166, .165, .164, .163,
00221	554*	°	.162, .161, .161, .160, .160,
00221	555*	°	.160, .159, .159, .159, .159,
00221	556*	°	.159, .158, .158, .158, .158,
00221	557*	°	.158, .158, .158,
00221	558*	C	

```

00221 559° C SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM D R - 440.880 PSIA
00221 560° C
00223 561° DATA (U6(J, 5),J=1,83) /
00223 562° ° .397, .397, .396, .396, .396,
00223 563° ° .397, .397, .397, .398, .398,
00223 564° ° .399, .400, .401, .401, .401,
00223 565° ° .402, .404, .406, .408, .411,
00223 566° ° .414, .418, .423, .428, .435,
00223 567° ° .442, .452, .463, .474, .474,
00223 568° ° .477, .501, .520, .520, .522,
00223 569° ° .555, .583, .583, .600, .676,
00223 570° ° .700, .605, .511, .483, .483,
00223 571° ° .449, .423, .423, .408, .381,
00223 572° ° .381, .380, .365, .365, .359,
00223 573° ° .342, .329, .318, .309, .294,
00223 574° ° .283, .275, .268, .263, .258,
00223 575° ° .254, .251, .240, .246, .243,
00223 576° ° .242, .240, .238, .237, .236,
00223 577° ° .235, .234, .233, .233, .232,
00223 578° ° .231, .231, .230/
00223 579° C
00223 580° C*****
00223 581° C
00223 582° C PRESSURE - PSIA
00223 583° C
00225 584° DATA UA(6) / 514.360 /
00225 585° C
00225 586° C DENSITY - LB/CU FT - FOR 514.360 PSIA
00225 587° C
00227 588° DATA (U1(J, 6),J=1,83) /
00227 589° ° 81.49959, 80.71025, 80.00000, 79.23930, 78.43137,
00227 590° ° 77.70008, 76.92308, 76.10350, 75.35795, 74.51565,
00227 591° ° 73.74631, 72.93946, 72.09805, 71.71589, 71.71589,
00227 592° ° 71.27584, 70.42253, 69.54103, 68.68132, 67.75068,
00227 593° ° 66.84492, 65.91958, 64.93506, 63.93862, 62.93266,
00227 594° ° 61.84292, 60.71645, 59.55926, 58.54608, 58.54608,
00227 595° ° 58.30904, 56.98006, 55.73807, 55.73807, 55.58644,
00227 596° ° 54.02485, 52.93806, 52.93806, 52.30125, 50.32713,
00227 597° ° 50.02501, 50.02501, 47.89272, 46.55493, 40.04924,
00227 598° ° 9.46880, 8.97424, 8.97424, 8.71384, 8.51354,
00227 599° ° 8.51354, 8.15927, 7.85053, 7.85053, 7.71962,
00227 600° ° 7.35402, 7.04176, 6.76956, 6.52784, 6.11396,
00227 601° ° 5.76901, 5.47375, 5.21648, 4.98927, 4.78606,
00227 602° ° 4.60278, 4.43616, 4.28376, 4.14336, 4.01381,
00227 603° ° 3.89332, 3.78100, 3.67607, 3.57756, 3.48493,
00227 604° ° 3.39766, 3.31510, 3.23698, 3.16276, 3.09234,
00227 605° ° 3.02517, 2.96121, 2.90006/
00227 606° C
00227 607° C ISOTHERM DERIVATIVE - ALL VALUES SET TO ZERO
00227 608° C
00231 609° DATA (U2(J, 6),J=1,83) / 83*0. /
00231 610° C
00231 611° C ISOCHORE DERIVATIVE - ALL VALUES SET TO ZERO
00231 612° C
00233 613° DATA (U3(J, 6),J=1,83) / 83*0. /
00233 614° C
00233 615° C ENTHALPY - BTU/LB - FOR 514.360 PSIA
00233 616° C

```

DATA (U4(J, 6), J=1, 83) /					
00235 617*	-81.347,	-77.365,	-77.384,	-75.402,	-73.421,
00235 618*	-71.440,	-67.457,	-67.474,	-65.488,	-63.500,
00235 619*	-61.508,	-57.513,	-57.512,	-56.580,	-56.580,
00235 620*	-55.506,	-53.492,	-51.470,	-49.437,	-47.393,
00235 621*	-45.334,	-43.258,	-41.163,	-39.044,	-36.897,
00235 622*	-34.717,	-32.496,	-30.228,	-28.341,	-28.341,
00235 623*	-27.900,	-25.467,	-23.229,	-23.229,	-22.956,
00235 624*	-20.321,	-18.573,	-18.573,	-17.526,	-14.493,
00235 625*	-14.065,	-14.065,	-11.044,	-9.270,	37.071,
00235 626*	37.072,	37.272,	37.272,	40.033,	40.233,
00235 627*	40.223,	42.529,	42.729,	42.729,	44.750,
00235 628*	46.787,	48.691,	50.494,	52.217,	55.481,
00235 629*	58.563,	61.511,	64.357,	67.121,	69.820,
00235 630*	72.464,	75.063,	77.623,	80.150,	82.649,
00235 631*	85.122,	87.573,	90.005,	92.420,	94.819,
00235 632*	97.206,	99.580,	101.944,	104.298,	106.644,
00235 633*	108.983,	111.316,	113.642,		
00235 634*					
00235 635*					
00235 636*					
00235 637*					
00237 638*					
00237 639*					
00237 640*					
00237 641*					
00237 642*					
00237 643*					
00237 644*					
00237 645*					
00237 646*					
00237 647*					
00237 648*					
00237 649*					
00237 650*					
00237 651*					
00237 652*					
00237 653*					
00237 654*					
00237 655*					
00237 656*					
00237 657*					
00237 658*					
00241 659*					
00241 660*					
00241 661*					
00241 662*					
00241 663*					
00241 664*					
00241 665*					
00241 666*					
00241 667*					
00241 668*					
00241 669*					
00241 670*					
00241 671*					
00241 672*					
00241 673*					
00241 674*					

C
 C
 C
 DATA (U5(J, 6), J=1, 83) /
 * .265, .261, .256, .253, .249,
 * .245, .242, .238, .235, .232,
 * .229, .227, .224, .223, .223,
 * .221, .219, .217, .214, .212,
 * .210, .208, .206, .204, .202,
 * .200, .199, .197, .195, .195,
 * .195, .199, .197, .197, .197,
 * .196, .196, .196, .196, .197,
 * .197, .197, .199, .202, .217,
 * .209, .202, .202, .200, .195,
 * .195, .193, .190, .190, .188,
 * .184, .181, .179, .176, .173,
 * .170, .168, .167, .165, .164,
 * .163, .162, .162, .161, .161,
 * .160, .160, .160, .159, .159,
 * .159, .159, .159, .159, .159,
 * .159, .159, .159/
 C
 C
 C
 DATA (U6(J, 6), J=1, 83) /
 * .397, .396, .396, .396, .396,
 * .396, .397, .397, .397, .398,
 * .399, .399, .401, .401, .401,
 * .402, .404, .405, .408, .410,
 * .413, .417, .421, .426, .432,
 * .440, .448, .459, .470, .470,
 * .472, .494, .509, .509, .511,
 * .542, .565, .565, .579, .636,
 * .651, .651, .759, .840, .799,
 * .664, .583, .583, .536, .488,
 * .488, .468, .438, .438, .424,
 * .393, .370, .352, .338, .316,
 * .301, .289, .280, .273, .267,
 * .262, .258, .254, .251, .249,
 * .246, .244, .242, .241, .239,

SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 514.360 PSIA
 SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM O R - 514.360 PSIA

```

00241 675* * .238, .237, .236, .235, .234,
00241 676* * .234, .233, .232/
00241 677* C
00241 678* C*****
00241 679* C
00241 680* C
00241 681* C
00243 682* DATA UA(7) / 587.840 /
00243 683* C
00243 684* C DENSITY = LB/CU FT = FOR 587.840 PSIA
00243 685* C
00245 686* DATA (U1(J, 7),J=1,83) /
00245 687* * 81.49959, 80.77544, 80.00000, 79.23930, 78.49294,
00245 688* * 77.70008, 76.92308, 76.16146, 75.35795, 74.57121,
00245 689* * 73.80074, 72.99270, 72.15007, 71.76736, 71.76736,
00245 690* * 71.32668, 70.47216, 69.63788, 68.72852, 67.84260,
00245 691* * 66.93440, 66.00660, 65.06181, 64.06150, 63.05170,
00245 692* * 61.99628, 60.90134, 59.73716, 58.77347, 58.77347,
00245 693* * 58.54801, 57.24098, 56.01553, 56.01553, 55.86592,
00245 694* * 54.37738, 53.35500, 53.35500, 52.74202, 50.86470,
00245 695* * 50.59448, 50.59448, 48.68549, 47.42373, 47.42373,
00245 696* * 45.87156, 43.36513, 42.43472, 41.71097, 40.79765,
00245 697* * 40.79765, 40.46682, 39.89839, 39.89839, 39.66370,
00245 698* * 39.06454, 38.58443, 38.18398, 37.84006, 37.27326,
00245 699* * 36.81570, 36.43418, 36.10762, 35.82276, 35.57103,
00245 700* * 35.34616, 35.14324, 34.95860, 34.78973, 34.63435,
00245 701* * 34.49055, 34.35711, 34.23263, 34.11641, 34.00721,
00245 702* * 33.90442, 33.80764, 33.71609, 33.62937, 33.54711,
00245 703* * 33.46885, 33.39432, 33.32325/
00245 704* C
00245 705* C ISOTHERM DERIVATIVE = ALL VALUES SET TO ZERO
00245 706* C
00247 707* DATA (U2(J, 7),J=1,83) / 83.00 /
00247 708* C
00247 709* C ISOCHORE DERIVATIVE = ALL VALUES SET TO ZERO
00247 710* C
00251 711* DATA (U3(J, 7),J=1,83) / 83.00 /
00251 712* C
00251 713* C ENTHALPY = BTU/LB = FOR 587.840 PSIA
00251 714* C
00253 715* DATA (U4(J, 7),J=1,83) /
00253 716* * -81.211, -79.230, -77.249, -75.269, -73.289,
00253 717* * -71.308, -69.327, -67.345, -65.361, -63.374,
00253 718* * -61.385, -59.391, -57.393, -55.462, -53.462,
00253 719* * -55.389, -53.379, -51.360, -49.331, -47.291,
00253 720* * -45.237, -43.167, -41.079, -38.968, -36.831,
00253 721* * -34.662, -32.456, -30.205, -28.335, -26.335,
00253 722* * -27.898, -25.492, -23.285, -23.285, -23.016,
00253 723* * -20.430, -18.726, -18.726, -17.706, -14.784,
00253 724* * -14.385, -14.385, -11.551, -9.844, -9.844,
00253 725* * -7.744, -4.650, 32.316, 34.251, 36.995,
00253 726* * 36.995, 38.107, 40.145, 40.145, 41.057,
00253 727* * 43.571, 45.818, 47.885, 49.819, 53.402,
00253 728* * 56.719, 59.849, 62.842, 65.728, 68.530,
00253 729* * 71.264, 73.941, 76.570, 79.158, 81.711,
00253 730* * 84.234, 86.731, 89.204, 91.656, 94.091,
00253 731* * 96.510, 98.914, 101.305, 103.686, 106.056,
00253 732* * 108.417, 110.771, 113.118/

```

```

00253 733* C
00253 734* C SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 587.840 PSIA
00253 735* C
00255 736* DATA (U5(J, 7), J=1,83)
00255 737* * .265, .261, .257, .253, .249,
00255 738* * .245, .242, .239, .235, .232,
00255 739* * .230, .227, .224, .223, .223,
00255 740* * .222, .219, .217, .215, .212,
00255 741* * .210, .208, .206, .204, .202,
00255 742* * .200, .199, .197, .195, .195,
00255 743* * .195, .199, .197, .197, .197,
00255 744* * .196, .195, .195, .195, .196,
00255 745* * .196, .196, .198, .200, .200,
00255 746* * .202, .208, .227, .220, .210,
00255 747* * .210, .206, .200, .200, .198,
00255 748* * .192, .167, .184, .181, .176,
00255 749* * .173, .170, .168, .167, .165,
00255 750* * .164, .163, .163, .162, .161,
00255 751* * .161, .161, .160, .160, .160,
00255 752* * .159, .159, .159, .159, .159,
00255 753* * .159, .159, .159/
00255 754* C
00255 755* C SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM O R - 587.840 PSIA
00255 756* C
00257 757* DATA (U6(J, 7), J=1,83) /
00257 758* * .396, .396, .396, .396, .396,
00257 759* * .396, .396, .397, .397, .398,
00257 760* * .398, .399, .400, .400, .400,
00257 761* * .401, .403, .405, .407, .409,
00257 762* * .412, .416, .420, .425, .430,
00257 763* * .437, .445, .455, .465, .465,
00257 764* * .467, .488, .501, .501, .503,
00257 765* * .530, .550, .550, .562, .607,
00257 766* * .618, .618, .697, .766, .766,
00257 767* * .850, 1.168, 1.214, .943, .738,
00257 768* * .738, .655, .574, .574, .538,
00257 769* * .472, .429, .399, .376, .343,
00257 770* * .321, .306, .294, .284, .277,
00257 771* * .270, .265, .261, .257, .254,
00257 772* * .251, .248, .246, .244, .243,
00257 773* * .241, .240, .239, .238, .237,
00257 774* * .236, .235, .234/
00257 775* C
00257 776* C*****
00257 777* C
00257 778* C PRESSURE - PSIA
00257 779* C
00261 780* DATA UA(8) / 661.320 /
00261 781* C
00261 782* C DENSITY - LB/CU FT - FOR 661.320 PSIA
00261 783* C
00263 784* DATA (U1(J, 8), J=1,83) /
00263 785* * 81.56607, 80.77544, 80.06405, 79.30214, 78.55459,
00263 786* * 77.76050, 76.98229, 76.21951, 75.41478, 74.62686,
00263 787* * 73.85524, 73.04602, 72.20217, 71.81890, 71.81890,
00263 788* * 71.37759, 70.57163, 69.68641, 68.82312, 67.93478,
00263 789* * 67.02413, 66.09385, 65.14658, 64.18485, 63.17119,
00263 790* * 62.15040, 61.05006, 59.91612, 58.97467, 58.97467,

```

00263 791* * 58.75441, 57.47124, 56.26409, 56.26409, 56.11672,
 00263 792* * 54.70460, 53.70530, 53.70530, 53.10674, 51.36107,
 00263 793* * 51.11273, 51.11273, 49.35834, 48.25795, 48.25795,
 00263 794* * 46.90431, 44.71598, 44.71598, 43.55401, 39.30818,
 00263 795* * 15.77536, 14.45923, 12.94703, 12.94703, 12.36858,
 00263 796* * 11.23343, 10.44059, 9.82994, 9.33184, 8.54920,
 00263 797* * 7.94534, 7.45601, 7.04573, 6.69389, 6.38610,
 00263 798* * 6.11396, 5.87061, 5.65068, 5.45048, 5.26704,
 00263 799* * 5.09840, 4.94218, 4.79708, 4.66179, 4.53535,
 00263 800* * 4.41638, 4.30459, 4.19903, 4.09937, 4.00481,
 00263 801* * 3.91497, 3.82966, 3.74841/
 00263 802* C

ISOTHERM DERIVATIVE - ALL VALUES SET TO ZERO

DATA (U2(J, 8),J=1,83) / 83*0. /

ISOCORE DERIVATIVE - ALL VALUES SET TO ZERO

DATA (U3(J, 8),J=1,83) / 83*0. /

ENTHALPY - BTU/LB - FOR 661.320 PSIA

DATA (U4(J, 8),J=1,83) /

* -81.075, -79.094, -77.114, -75.135, -73.156,
 * -71.177, -69.197, -67.216, -65.233, -63.248,
 * -61.261, -59.269, -57.274, -56.344, -56.344,
 * -55.273, -53.265, -51.249, -49.224, -47.189,
 * -45.140, -43.076, -40.994, -38.891, -36.763,
 * -34.605, -32.412, -30.177, -28.324, -28.324,
 * -27.890, -25.510, -23.330, -23.330, -23.064,
 * -20.523, -18.858, -18.858, -17.860, -15.032,
 * -14.650, -14.650, -11.953, -10.389, -10.389,
 * -8.464, -5.716, -5.716, -4.145, .635,
 * 28.133, 30.890, 34.518, 34.518, 36.141,
 * 39.640, 42.472, 44.938, 47.167, 51.168,
 * 54.771, 58.115, 61.274, 64.296, 67.211,
 * 70.041, 72.801, 75.503, 78.156, 80.766,
 * 83.341, 85.884, 88.400, 90.892, 93.362,
 * 95.813, 98.248, 100.668, 103.074, 105.469,
 * 107.853, 110.228, 112.595/

SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 661.320 PSIA

DATA (U5(J, 8),J=1,83) /

* .265, .261, .257, .253, .249,
 * .245, .242, .239, .236, .233,
 * .230, .227, .224, .223, .223,
 * .222, .219, .217, .215, .213,
 * .211, .208, .206, .204, .203,
 * .201, .199, .197, .195, .195,
 * .195, .199, .197, .197, .197,
 * .196, .195, .195, .195, .196,
 * .196, .196, .197, .198, .198,
 * .200, .204, .204, .206, .223,
 * .249, .233, .218, .218, .212,
 * .202, .195, .190, .185, .180,
 * .175, .172, .170, .168, .167,
 * .165, .164, .164, .163, .162,

```

00273 849* * .162, .161, .161, .160, .160,
00273 850* * .160, .160, .159, .159, .159,
00273 851* * .159, .159, .159/
00273 852* C
00273 853* C SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM O R - 661.320 PSIA
00273 854* C
00275 855* DATA (U6(J, 8), J=1, 83) /
00275 856* * .396, .396, .396, .396, .396,
00275 857* * .396, .396, .396, .397, .397,
00275 858* * .398, .399, .400, .400, .400,
00275 859* * .401, .402, .404, .406, .408,
00275 860* * .411, .414, .418, .423, .428,
00275 861* * .435, .442, .451, .460, .460,
00275 862* * .462, .482, .494, .494, .495,
00275 863* * .519, .537, .537, .547, .586,
00275 864* * .594, .594, .653, .697, .697,
00275 865* * .751, .913, .913, 1.006, 2.072,
00275 866* * 2.673, 1.480, 1.016, 1.016, .809,
00275 867* * .618, .524, .467, .427, .377,
00275 868* * .346, .324, .308, .296, .287,
00275 869* * .279, .273, .268, .263, .259,
00275 870* * .256, .253, .250, .248, .246,
00275 871* * .244, .243, .241, .240, .239,
00275 872* * .238, .237, .236/
00275 873* C
00275 874* C*****
00275 875* C
00275 876* C PRESSURE - PSIA
00275 877* C
00277 878* DATA UA(9) / 734.800 /
00277 879* C
00277 880* C DENSITY - LB/CU FT - FOR 734.800 PSIA
00277 881* C
00301 882* DATA (U1(J, 9), J=1, 83) /
00301 883* * 81.56607, 80.84074, 80.06405, 79.36508, 78.55459,
00301 884* * 77.82101, 77.04160, 76.27765, 75.47170, 74.68260,
00301 885* * 73.90983, 73.09941, 72.30658, 71.92221, 71.92221,
00301 886* * 71.47963, 70.62147, 69.78367, 68.91799, 68.02721,
00301 887* * 67.11409, 66.22517, 65.27415, 64.30868, 63.33122,
00301 888* * 62.30530, 61.23699, 60.09615, 59.14909, 59.14909,
00301 889* * 58.92752, 57.70340, 56.54322, 56.54322, 56.40158,
00301 890* * 55.00550, 54.04891, 54.04891, 53.47594, 51.81347,
00301 891* * 51.57931, 51.57931, 49.92511, 48.93182, 48.93182,
00301 892* * 47.70992, 45.91221, 45.91221, 44.94382, 41.88929,
00301 893* * 41.88929, 40.76641, 30.24803, 24.18380, 17.71793,
00301 894* * 14.33075, 12.82051, 11.81754, 11.06807, 9.97009,
00301 895* * 9.17179, 8.54701, 8.03600, 7.60514, 7.23327,
00301 896* * 6.90799, 6.61901, 6.36011, 6.12595, 5.91226,
00301 897* * 5.71657, 5.53649, 5.36942, 5.21404, 5.06919,
00301 898* * 4.93340, 4.80584, 4.68582, 4.57247, 4.46528,
00301 899* * 4.36357, 4.26712, 4.17519/
00301 900* C
00301 901* C ISOTHERM DERIVATIVE - ALL VALUES SET TO ZERO
00301 902* C
00303 903* DATA (UZ(J, 9), J=1, 83) / 83.00 /
00303 904* C
00303 905* C ISOCHORE DERIVATIVE - ALL VALUES SET TO ZERO
00303 906* C

```

00305 907* DATA (U3(J, 9),J=1,83) / 83*0. /
 00305 908*
 00305 909* C
 00305 910* C
 00307 911* ENTHALPY - BTU/LB - FOR 734.800 PSIA
 00307 912*

DATA (U4(J, 9),J=1,83) /
 * -80.939, -78.959, -76.980, -75.001, -73.023,
 * -71.045, -69.066, -67.087, -65.105, -63.122,
 * -61.137, -59.147, -57.154, -56.225, -56.225,
 * -55.155, -53.151, -51.138, -49.117, -47.086,
 * -45.042, -42.983, -40.908, -38.812, -36.693,
 * -34.546, -32.365, -30.145, -28.308, -28.308,
 * -27.878, -25.521, -23.367, -23.367, -23.104,
 * -20.602, -18.970, -18.970, -17.992, -15.239,
 * -14.872, -14.872, -12.283, -10.820, -10.820,
 * -9.021, -6.594, -6.594, -5.212, -1.564,
 * -1.564, -0.055, 10.621, 17.558, 27.239,
 * 34.325, 38.364, 41.508, 44.182, 48.747,
 * 52.707, 56.302, 59.652, 62.824, 65.863,
 * 68.796, 71.645, 74.423, 77.144, 79.815,
 * 82.443, 85.035, 87.594, 90.126, 92.633,
 * 95.118, 97.583, 100.032, 102.465, 104.844,
 * 107.291, 109.688, 112.075/

00307 929* C
 00307 930* C
 00307 931* C
 00307 932* SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 734.800 PSIA
 00307 933*

DATA (U5(J, 9),J=1,83) /
 * .265, .261, .257, .253, .249,
 * .246, .242, .239, .236, .233,
 * .230, .227, .225, .224, .224,
 * .222, .220, .217, .215, .213,
 * .211, .209, .207, .205, .203,
 * .201, .199, .197, .195, .195,
 * .195, .199, .197, .197, .197,
 * .196, .195, .195, .195, .195,
 * .195, .195, .196, .197, .197,
 * .198, .200, .200, .202, .210,
 * .210, .213, .267, .288, .247,
 * .217, .205, .197, .191, .183,
 * .178, .175, .172, .170, .168,
 * .167, .165, .164, .164, .163,
 * .162, .162, .161, .161, .160,
 * .160, .160, .160, .159, .159,
 * .159, .159, .159/

00311 950* C
 00311 951* C
 00311 952* C
 00313 953* SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM O R - 734.800 PSIA
 00313 954*

DATA (U6(J, 9),J=1,83) /
 * .396, .396, .396, .396, .396,
 * .396, .396, .396, .396, .397,
 * .397, .398, .399, .399, .399,
 * .400, .402, .403, .405, .407,
 * .410, .413, .417, .421, .426,
 * .432, .440, .448, .456, .456,
 * .458, .477, .488, .488, .489,
 * .510, .525, .525, .534, .568,
 * .574, .574, .620, .652, .652,
 * .692, .782, .782, .834, 1.180,
 * 1.180, 1.325, 87.267, 131.184, 2.514,


```

00313 965*      *      .960      .698,      .573,      .502,      .420,
00313 966*      *      .37      .346,      .325,      .310,      .298,
00313 967*      *      .28      .281,      .275,      .269,      .265,
00313 968*      *      .261,      .257,      .254,      .252,      .250,
00313 969*      *      .247,      .246,      .244,      .243,      .241,
00313 970*      *      .240,      .239,      .238/
00313 971*      C
00313 972*      C*****
00313 973*      C
00313 974*      C      PRESSURE - PSIA
00313 975*      C
00315 976*      DATA UA(10) / 808.280 /
00315 977*      C
00315 978*      C      DENSITY - LB/CU FT - FOR 808.280 PSIA
00315 979*      C
00317 980*      DATA (U1(J,10),J=1,83) /
00317 981*      * 81.63265, 80.90615, 80.12820, 79.36508, 78.61635,
00317 982*      * 77.88162, 77.10100, 76.33588, 75.52870, 74.73841,
00317 983*      * 73.96450, 73.15289, 72.35890, 71.97398, 71.97398,
00317 984*      * 71.53076, 70.67138, 69.83240, 69.01311, 68.11989,
00317 985*      * 67.24949, 66.31300, 65.40222, 64.43299, 63.45178,
00317 986*      * 62.42197, 61.38735, 60.27728, 59.35288, 59.35288,
00317 987*      * 59.13661, 57.90388, 56.76427, 56.76427, 56.62514,
00317 988*      * 55.27916, 54.36742, 54.36742, 53.82131, 52.21932,
00317 989*      * 52.00043, 52.00043, 50.45409, 49.54476, 49.54476,
00317 990*      * 48.42615, 46.83880, 46.83880, 45.97701, 43.66280,
00317 991*      * 43.66280, 42.78990, 38.93346, 38.93346, 37.42515,
00317 992*      * 20.56344, 16.22060, 14.35544, 13.15270, 11.57407,
00317 993*      * 10.51193, 9.71628, 9.08265, 8.55871, 8.11359,
00317 994*      * 7.72857, 7.38934, 7.08717, 6.81617, 6.56987,
00317 995*      * 6.34558, 6.13949, 5.94919, 5.77267, 5.60852,
00317 996*      * 5.45524, 5.31124, 5.17625, 5.04872, 4.92854,
00317 997*      * 4.81464, 4.70655, 4.60384/
00317 998*      C
00317 1000*      C      ISOTHERM DERIVATIVE - ALL VALUES SET TO ZERO
00321 1001*      C      DATA (U2(J,10),J=1,83) / 83.0. /
00321 1002*      C
00321 1003*      C      ISOCHORE DERIVATIVE - ALL VALUES SET TO ZERO
00321 1004*      C
00323 1005*      C      DATA (U3(J,10),J=1,83) / 83.0. /
00323 1006*      C
00323 1007*      C      ENTHALPY - BTU/LB - FOR 808.280 PSIA
00323 1008*      C
00325 1009*      DATA (U4(J,10),J=1,83) /
00325 1010*      * -80.803, -78.823, -76.845, -74.867, -72.890,
00325 1011*      * -70.913, -68.936, -66.957, -64.978, -62.996,
00325 1012*      * -61.012, -59.025, -57.034, -55.046, -53.056,
00325 1013*      * -51.038, -49.036, -47.027, -45.009, -43.982,
00325 1014*      * -41.943, -39.890, -37.820, -35.732, -33.621,
00325 1015*      * -31.484, -29.316, -27.110, -24.887, -22.647,
00325 1016*      * -20.360, -18.025, -15.635, -13.195, -10.715,
00325 1017*      * -8.168, -5.465, -2.632, 0.232, 3.165,
00325 1018*      * 6.040, 8.744, 11.231, 13.584, 15.804,
00325 1019*      * 17.888, 19.732, 21.332, 22.584, 23.484,
00325 1020*      * 24.012, 24.174, 23.841, 23.039, 21.781,
00325 1021*      * 20.050, 16.804, 12.971, 8.511, 3.485,
00325 1022*

```

% FOR, * TPOCB1,TPOCB1

DATE 310871 PAGE 284

00325 1023* * 67.530, 70.472, 73.332, 76.123, 78.856,
00325 1024* * 81.540, 84.182, 86.786, 89.359, 91.903,
00325 1025* * 94.422, 96.919, 99.397, 101.857, 104.301,
00325 1026* * 106.732, 109.150, 111.557/

C
C
C

SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 808.280 PSIA

DATA (U5(J,10),J=1,83) /

00327 1031* * .265, .261, .257, .253, .249,
00327 1032* * .246, .242, .239, .236, .233,
00327 1033* * .230, .227, .225, .224, .224,
00327 1034* * .222, .220, .218, .215, .213,
00327 1035* * .211, .209, .207, .205, .203,
00327 1036* * .201, .199, .197, .195, .195,
00327 1037* * .195, .199, .197, .197, .197,
00327 1038* * .196, .195, .195, .195, .195,
00327 1039* * .195, .195, .195, .196, .196,
00327 1040* * .197, .198, .198, .199, .203,
00327 1041* * .203, .205, .217, .217, .223,
00327 1042* * .249, .219, .206, .198, .188,
00327 1043* * .181, .177, .174, .171, .169,
00327 1044* * .168, .166, .165, .164, .164,
00327 1045* * .163, .162, .162, .161, .161,
00327 1046* * .161, .160, .160, .160, .160,
00327 1047* * .159, .159, .159/

C
C
C

SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM O R - 808.280 PSIA

DATA (U6(J,10),J=1,83) /

00331 1051* * .396, .396, .396, .395, .395,
00331 1052* * .395, .396, .396, .396, .396,
00331 1053* * .397, .398, .399, .399, .399,
00331 1054* * .400, .401, .403, .404, .407,
00331 1055* * .409, .412, .416, .420, .425,
00331 1056* * .430, .437, .445, .452, .452,
00331 1057* * .454, .472, .482, .482, .483,
00331 1058* * .502, .516, .516, .524, .553,
00331 1059* * .558, .558, .558, .594, .620,
00331 1060* * .651, .712, .712, .747, .906,
00331 1061* * .906, .971, 1.549, 1.549, 1.808,
00331 1062* * 2.731, 1.075, .763, .615, .477,
00331 1063* * .411, .371, .344, .325, .310,
00331 1064* * .299, .290, .282, .276, .271,
00331 1065* * .266, .262, .259, .256, .253,
00331 1066* * .251, .249, .247, .245, .244,
00331 1067* * .242, .241, .240/

C
C

PRESSURE - PSIA

DATA UA(11) / 881.760 /

C
C
C

DENSITY - LB/CU FT - FOR 881.760 PSIA

DATA (U1(J,11),J=1,83) /

00335 1078* * 81.63265, 80.90615, 80.19246, 79.42812, 78.67821,
00335 1079* * 77.88162, 77.16049, 76.33588, 75.50579, 74.79431,
00335 1080*

```

00335 1081* 74.01925, 73.20644, 72.41130, 72.02582, 72.02582,
00335 1082* 71.58196, 71.77141, 69.93007, 69.06077, 68.21282,
00335 1083* 67.34007, 67.40106, 65.48788, 64.55778, 63.57279,
00335 1084* 62.57822, 61.53846, 60.45949, 59.52955, 59.52955,
00335 1085* 59.31198, 58.13953, 57.01955, 57.01955, 56.88282,
00335 1086* 55.55556, 54.67143, 54.67143, 54.14185, 52.60389,
00335 1087* 52.39465, 52.39465, 50.91650, 50.06594, 50.06594,
00335 1088* 49.01941, 47.60910, 47.60910, 46.83841, 44.87888,
00335 1089* 44.87888, 44.13063, 41.51036, 41.51036, 40.43672,
00335 1090* 33.78378, 22.22716, 17.86033, 15.76541, 13.41562,
00335 1091* 11.98610, 10.97333, 10.19160, 9.55840, 9.02935,
00335 1092* 8.57633, 8.18130, 7.83269, 7.52106, 7.24008,
00335 1093* 6.98470, 6.75128, 6.53637, 6.33794, 6.15347,
00335 1094* 5.98158, 5.82072, 5.66990, 5.52822, 5.39433,
00335 1095* 5.26759, 5.14774, 5.03398/

```

ISOTHERM DERIVATIVE - ALL VALUES SET TO ZERO

DATA {U2(J,11),J=1,83} / 83*0. /

ISOCORE DERIVATIVE - ALL VALUES SET TO ZERO

DATA {U3(J,11),J=1,83} / 83*0. /

ENTHALPY - BTU/LB - FOR 881.760 PSIA

DATA {U4(J,11),J=1,83} /

```

* -80.666, -78.688, -76.710, -74.734, -72.757,
* -70.781, -68.805, -66.828, -64.850, -62.870,
* -60.888, -58.903, -56.914, -55.987, -55.987,
* -54.920, -52.921, -50.915, -48.901, -46.878,
* -44.843, -42.795, -40.732, -38.651, -36.548,
* -34.420, -32.263, -30.071, -28.261, -28.261,
* -27.838, -25.524, -23.415, -23.415, -23.158,
* -20.723, -19.146, -19.146, -18.202, -15.570,
* -15.226, -15.226, -12.793, -11.456, -11.456,
* -9.811, -7.729, -7.729, -6.539, -3.857,
* -3.857, -2.770, .504, .504, 1.968,
* 9.714, 24.318, 32.001, 36.652, 43.172,
* 48.166, 52.415, 56.230, 59.757, 63.077,
* 66.242, 69.285, 72.230, 75.095, 77.893,
* 80.634, 83.327, 85.978, 88.592, 91.174,
* 93.728, 96.257, 98.764, 101.251, 103.720,
* 106.174, 108.614, 111.042/

```

SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 881.760 PSIA

DATA {U5(J,11),J=1,83} /

```

* .266, .261, .257, .253, .249,
* .246, .243, .239, .236, .233,
* .230, .228, .225, .224, .224,
* .223, .220, .218, .216, .213,
* .211, .209, .207, .205, .203,
* .201, .199, .197, .196, .196,
* .196, .199, .197, .197, .197,
* .196, .195, .195, .195, .195,
* .195, .195, .195, .195, .195,
* .196, .197, .197, .198, .200,

```

FOR, * TPOCB1, TPOCB1

DATE 310871 PAGE 284

00345	1139	*	.200,	.201,	.207,	.207,	.210,
00345	1140	*	.231,	.240,	.218,	.206,	.193,
00345	1141	*	.185,	.179,	.176,	.173,	.171,
00345	1142	*	.169,	.167,	.166,	.165,	.164,
00345	1143	*	.164,	.163,	.162,	.162,	.161,
00345	1144	*	.161,	.161,	.160,	.160,	.160,
00345	1145	*	.160,	.159,	.159,		

SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM D R - 881.760 PSIA

DATA (U4(J,11),J=1,83) /							
00347	1150	*	.396,	.396,	.395,	.395,	.395,
00347	1151	*	.395,	.395,	.395,	.396,	.396,
00347	1152	*	.397,	.397,	.398,	.398,	.398,
00347	1153	*	.399,	.400,	.402,	.404,	.406,
00347	1154	*	.408,	.411,	.414,	.418,	.423,
00347	1155	*	.428,	.434,	.442,	.449,	.449,
00347	1156	*	.451,	.467,	.477,	.477,	.478,
00347	1157	*	.495,	.507,	.507,	.514,	.540,
00347	1158	*	.544,	.544,	.573,	.595,	.595,
00347	1159	*	.621,	.665,	.665,	.691,	.788,
00347	1160	*	.788,	.827,	1.021,	1.021,	1.108,
00347	1161	*	2.337,	2.209,	1.127,	.789,	.554,
00347	1162	*	.454,	.400,	.365,	.341,	.324,
00347	1163	*	.310,	.299,	.290,	.283,	.277,
00347	1164	*	.272,	.267,	.263,	.260,	.257,
00347	1165	*	.254,	.252,	.250,	.248,	.246,
00347	1166	*	.245,	.243,	.242,		

PRESSURE - PSIA

DATA U4(12) / 955.240 /

DENSITY - LB/CU FT - FOR 955.240 PSIA

DATA (U1(J,12),J=1,83) /							
00353	1176	*	81.69935,	80.97166,	80.19246,	79.42812,	78.67821,
00353	1177	*	77.94232,	77.16049,	76.39419,	75.64297,	74.85030,
00353	1178	*	74.07407,	73.26007,	72.46377,	72.10161,	72.10161,
00353	1180	*	71.68459,	70.82153,	69.97901,	69.15629,	68.30601,
00353	1181	*	67.43088,	66.53360,	65.61680,	64.64124,	63.69427,
00353	1182	*	62.69592,	61.69031,	60.60606,	59.70031,	59.70031,
00353	1183	*	59.48840,	58.34306,	57.24435,	57.24435,	57.11022,
00353	1184	*	55.63473,	54.96033,	54.96033,	54.43658,	52.96610,
00353	1185	*	52.76708,	52.76708,	51.36107,	50.56180,	50.56180,
00353	1186	*	49.57858,	48.26923,	48.26923,	47.55112,	45.82977,
00353	1187	*	45.82977,	45.16712,	43.05729,	43.05729,	42.17630,
00353	1188	*	37.96507,	30.94059,	23.08936,	19.17178,	15.55210,
00353	1189	*	13.62027,	12.32742,	11.36622,	10.60670,	9.98109,
00353	1190	*	9.45269,	8.99604,	8.59623,	8.24063,	7.92205,
00353	1191	*	7.63417,	7.37137,	7.13063,	6.90894,	6.70331,
00353	1192	*	6.51254,	6.33392,	6.16713,	6.00998,	5.86235,
00353	1193	*	5.72279,	5.59065,	5.46538,		

ISOTHERM DERIVATIVE - ALL VALUES SET TO ZERO

```

00355 1197* DATA (U2(J,12),J=1,83) / 83*0. /
00355 1198* C
00355 1199* C ISOCHORIC DERIVATIVE - ALL VALUES SET TO ZERO
00355 1200* C
00357 1201* DATA (U3(J,12),J=1,83) / 83*0. /
00357 1202* C
00357 1203* C ENTHALPY - BTU/LB - FOR 955.240 PSIA
00357 1204* C
00361 1205* DATA (U4(J,12),J=1,83) /
00361 1206* * -80.530, -78.552, -76.576, -74.600, -72.625,
00361 1207* * -70.649, -68.674, -66.699, -64.722, -62.744,
00361 1208* * -60.763, -58.780, -56.793, -55.868, -55.868,
00361 1209* * -54.802, -52.806, -50.803, -48.792, -46.773,
00361 1210* * -44.742, -42.700, -40.642, -38.568, -36.473,
00361 1211* * -34.355, -32.269, -30.030, -28.233, -28.233,
00361 1212* * -27.812, -25.518, -23.429, -23.429, -23.174,
00361 1213* * -20.768, -19.215, -19.215, -18.284, -15.702,
00361 1214* * -15.366, -15.366, -12.995, -11.704, -11.704,
00361 1215* * -10.115, -8.135, -8.135, -7.003, -4.530,
00361 1216* * -4.530, -3.528, -3.528, -3.528, -3.528,
00361 1217* * 5.849, 14.291, 24.920, 31.718, 39.925,
00361 1218* * 45.651, 50.332, 54.430, 58.163, 61.642,
00361 1219* * 64.934, 68.083, 71.110, 74.059, 76.925,
00361 1220* * 79.725, 82.471, 85.169, 87.825, 90.446,
00361 1221* * 93.035, 95.597, 98.133, 100.647, 103.142,
00361 1222* * 105.620, 108.081, 110.529/
00361 1223* C
00361 1224* C SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 955.240 PSIA
00361 1225* C
00363 1226* DATA (U5(J,12),J=1,83) /
00363 1227* * .266, .261, .257, .253, .250,
00363 1228* * .246, .243, .239, .236, .233,
00363 1229* * .231, .228, .225, .224, .224,
00363 1230* * .223, .220, .218, .216, .214,
00363 1231* * .211, .209, .207, .205, .203,
00363 1232* * .201, .199, .197, .196, .196,
00363 1233* * .196, .199, .198, .198, .198,
00363 1234* * .196, .195, .195, .195, .195,
00363 1235* * .195, .195, .195, .195, .195,
00363 1236* * .195, .196, .196, .196, .198,
00363 1237* * .198, .199, .202, .202, .204,
00363 1238* * .213, .234, .230, .215, .197,
00363 1239* * .188, .182, .177, .174, .172,
00363 1240* * .170, .168, .167, .166, .165,
00363 1241* * .164, .163, .163, .162, .162,
00363 1242* * .161, .161, .161, .160, .160,
00363 1243* * .160, .160, .159/
00363 1244* C
00363 1245* C SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM O R - 955.240 PSIA
00363 1246* C
00365 1247* DATA (U6(J,12),J=1,83) /
00365 1248* * .396, .395, .395, .395, .395,
00365 1249* * .395, .395, .395, .395, .396,
00365 1250* * .396, .397, .398, .398, .398,
00365 1251* * .399, .400, .401, .403, .405,
00365 1252* * .407, .410, .413, .417, .421,
00365 1253* * .426, .432, .439, .445, .445,
00365 1254* * .447, .463, .472, .472, .473,

```

00365	1255°	°	.488,	.499,	.499,	.505,	.528,
00365	1256°	°	.531,	.531,	.555,	.574,	.574,
00365	1257°	°	.597,	.631,	.631,	.650,	.718,
00365	1258°	°	.718,	.745,	.853,	.853,	.901,
00365	1259°	°	1.283,	2.201,	1.743,	1.075,	.654,
00365	1260°	°	.510,	.434,	.389,	.359,	.338,
00365	1261°	°	.321,	.309,	.299,	.290,	.283,
00365	1262°	°	.277,	.272,	.268,	.264,	.260,
00365	1263°	°	.257,	.255,	.252,	.250,	.249,
00365	1264°	°	.247,	.245,	.244,		

00365 1265° C
 00365 1266° C*****

00365 1267° C
 00365 1268° C PRESSURE - PSIA
 00365 1269° C

00367 1270° DATA UA(13) / 1028.720 /

00367 1271° C
 00367 1272° C DENSITY - LB/CU FT - FOR 1028.720 PSIA
 00367 1273° C

00371 1274° DATA (U1(J,13),J=1,83) /
 00371 1275° ° 81.69935, 80.97166, 80.25682, 79.49126, 78.74016,
 00371 1276° ° 78.00312, 77.22008, 76.45260, 75.70023, 74.90637,
 00371 1277° ° 74.12898, 73.31378, 72.51632, 72.15363, 72.15363,
 00371 1278° ° 71.73601, 70.92199, 70.07708, 69.25208, 68.35270,
 00371 1279° ° 67.52194, 66.62225, 65.70302, 64.76684, 63.81621,
 00371 1280° ° 62.85355, 61.80470, 60.79027, 59.87906, 59.87906,
 00371 1281° ° 59.66587, 58.51375, 57.46721, 57.46721, 57.33945,
 00371 1282° ° 56.08525, 55.24052, 55.24052, 54.73454, 53.30490,
 00371 1283° ° 53.11331, 53.11331, 51.75983, 51.00440, 51.00440,
 00371 1284° ° 50.07511, 48.86096, 48.86096, 48.19277, 46.62577,
 00371 1285° ° 46.62577, 46.01933, 44.20595, 44.20595, 43.44049,
 00371 1286° ° 40.16064, 35.58719, 29.26544, 23.57934, 18.05380,
 00371 1287° ° 15.43448, 13.78930, 12.61193, 11.70412, 10.96972,
 00371 1288° ° 10.35733, 9.83284, 9.37734, 8.97505, 8.61623,
 00371 1289° ° 8.29325, 8.00000, 7.73216, 7.48615, 7.25847,
 00371 1290° ° 7.04771, 6.85072, 6.66711, 6.49477, 6.33272,
 00371 1291° ° 6.17971, 6.03537, 5.89831 /

00371 1292° C
 00371 1293° C ISOTHERM DERIVATIVE - ALL VALUES SET TO ZERO

00371 1294° C
 00373 1295° DATA (U2(J,13),J=1,83) / 83°0. /

00373 1296° C
 00373 1297° C ISOCHORE DERIVATIVE - ALL VALUES SET TO ZERO

00373 1298° C
 00375 1299° DATA (U3(J,13),J=1,83) / 83°0. /

00375 1300° C
 00375 1301° C ENTHALPY - BTU/LB - FOR 1028.720 PSIA

00375 1302° C
 00377 1303° DATA (U4(J,13),J=1,83) /
 00377 1304° ° -80.394, -78.417, -76.441, -74.466, -72.492,
 00377 1305° ° -70.518, -68.544, -66.569, -64.594, -62.617,
 00377 1306° ° -60.638, -58.667, -56.672, -55.748, -55.748,
 00377 1307° ° -54.684, -52.690, -50.690, -48.683, -46.667,
 00377 1308° ° -44.641, -42.603, -40.552, -38.484, -36.396,
 00377 1309° ° -34.287, -32.151, -29.984, -28.199, -28.199,
 00377 1310° ° -27.781, -25.566, -23.436, -23.436, -23.183,
 00377 1311° ° -20.804, -19.272, -19.272, -18.354, -15.816,
 00377 1312° ° -15.488, -15.488, -13.168, -11.915, -11.915,

00377	1313*	°	-10.374,	-8.474,	-8.474,	-7.388,	-5.064,
00377	1314*	°	-5.064,	-4.122,	-1.573,	-1.573,	-1.433,
00377	1315*	°	3.966,	9.751,	17.774,	25.967,	36.336,
00377	1316*	°	42.967,	48.149,	52.571,	56.530,	60.180,
00377	1317*	°	63.609,	66.869,	69.997,	73.018,	75.953,
00377	1318*	°	78.814,	81.613,	84.360,	87.060,	89.720,
00377	1319*	°	92.345,	94.939,	97.505,	100.047,	102.567,
00377	1320*	°	105.068,	107.552,	110.020,		

00377 1321* C
00377 1322* C

SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 1028.720 PSIA

00377	1323*	C	DATA (U5(J,13),J=1,83)	/
00401	1324*	°	.266,	.262,
00401	1325*	°	.246,	.243,
00401	1326*	°	.231,	.228,
00401	1327*	°	.223,	.221,
00401	1328*	°	.212,	.210,
00401	1329*	°	.202,	.200,
00401	1330*	°	.196,	.199,
00401	1331*	°	.196,	.195,
00401	1332*	°	.194,	.194,
00401	1333*	°	.195,	.195,
00401	1334*	°	.196,	.197,
00401	1335*	°	.206,	.219,
00401	1336*	°	.191,	.184,
00401	1337*	°	.171,	.169,
00401	1338*	°	.165,	.164,
00401	1339*	°	.162,	.161,
00401	1340*	°	.160,	.160,

00401 1341* C
00401 1342* C
00401 1343* C

SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM O R - 1028.720 PSIA

00401	1344*	C	DATA (U6(J,13),J=1,83)	/
00403	1345*	°	.396,	.395,
00403	1346*	°	.395,	.395,
00403	1347*	°	.396,	.396,
00403	1348*	°	.398,	.399,
00403	1349*	°	.406,	.409,
00403	1350*	°	.424,	.430,
00403	1351*	°	.444,	.458,
00403	1352*	°	.482,	.492,
00403	1353*	°	.521,	.521,
00403	1354*	°	.578,	.604,
00403	1355*	°	.669,	.690,
00403	1356*	°	.992,	1.381,
00403	1357*	°	.574,	.474,
00403	1358*	°	.334,	.319,
00403	1359*	°	.283,	.277,
00403	1360*	°	.261,	.258,
00403	1361*	°	.249,	.248,

00403 1362* C
00403 1363* C

00403 1364* C
00403 1365* C

PRESSURE - PSIA

00403 1366* C
00403 1367* C

DATA UA(14) / 1102.200 /

00405 1368* C
00405 1369* C

DENSITY - LB/CU FT - FOR 1102.200 PSIA

00405 1370* C

00405 1371* C
 00407 1372* DATA (U1(J,14),J=1,83) /
 00407 1373* * 81.76615, 81.03728, 80.25682, 79.55449, 78.80221,
 00407 1374* * 78.00312, 77.27975, 76.51109, 75.75758, 74.96252,
 00407 1375* * 74.18398, 73.36757, 72.62164, 72.23394, 72.23394,
 00407 1376* * 71.78751, 70.97232, 70.12623, 69.30007, 68.44627,
 00407 1377* * 67.61325, 66.71114, 65.78947, 64.89293, 63.93862,
 00407 1378* * 64.18485, 61.95787, 61.95787, 60.24511, 60.24511,
 00407 1379* * 59.84440, 58.71991, 57.66606, 57.66606, 57.53740,
 00407 1380* * 56.30631, 55.49390, 55.49390, 55.06608, 53.61930,
 00407 1381* * 53.41880, 53.41880, 52.13764, 51.41388, 51.41388,
 00407 1382* * 50.53057, 49.40711, 49.40711, 48.75670, 47.30369,
 00407 1383* * 47.30369, 46.75082, 45.06534, 45.06534, 44.44444,
 00407 1384* * 41.66667, 38.15338, 33.57958, 28.27255, 20.93602,
 00407 1385* * 17.44287, 15.36570, 13.93146, 12.85347, 11.99616,
 00407 1386* * 11.29050, 10.69176, 10.17605, 9.72384, 9.32227,
 00407 1387* * 8.96218, 8.63707, 8.34028, 8.06907, 7.81861,
 00407 1388* * 7.58668, 7.37137, 7.17000, 6.98178, 6.80504,
 00407 1389* * 6.63834, 6.48130, 6.33232/

00407 1390* C
 00407 1391* C ISOTHERM DERIVATIVE - ALL VALUES SET TO ZERO

00407 1392* C
 00407 1393* C DATA (U2(J,14),J=1,83) / 83.0. /

00411 1394* C
 00411 1395* C ISOCORE DERIVATIVE - ALL VALUES SET TO ZERO

00411 1396* C
 00413 1397* C DATA (U3(J,14),J=1,83) / 83.0. /

00413 1398* C
 00413 1399* C ENTHALPY - BTU/LB - FOR 1102.200 PSIA

00413 1400* C
 00415 1401* C DATA (U4(J,14),J=1,83) /
 00415 1402* * -80.258, -78.281, -76.306, -74.332, -72.358,
 00415 1403* * -70.386, -68.413, -66.439, -64.465, -62.490,
 00415 1404* * -60.513, -58.534, -56.551, -55.628, -55.628,
 00415 1405* * -54.565, -52.574, -50.577, -48.573, -46.561,
 00415 1406* * -44.539, -42.506, -40.460, -38.398, -36.318,
 00415 1407* * -34.217, -32.091, -29.937, -28.162, -28.162,
 00415 1408* * -27.747, -25.469, -23.437, -23.437, -23.187,
 00415 1409* * -20.832, -19.981, -19.981, -18.413, -15.915,
 00415 1410* * -15.593, -15.593, -13.319, -12.098, -12.098,
 00415 1411* * -10.597, -8.756, -8.756, -7.713, -5.501,
 00415 1412* * -5.501, -4.605, -2.237, -2.237, -1.178,
 00415 1413* * 2.725, 7.433, 13.385, 20.528, 32.464,
 00415 1414* * 40.127, 45.872, 50.654, 54.863, 58.696,
 00415 1415* * 62.267, 65.644, 68.869, 71.973, 74.979,
 00415 1416* * 77.902, 80.756, 83.552, 86.296, 88.996,
 00415 1417* * 91.656, 94.263, 96.880, 99.449, 101.995,
 00415 1418* * 104.520, 107.025, 109.514/

00415 1419* C
 00415 1420* C SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 1102.200 PSIA

00415 1421* C
 00417 1422* C DATA (U5(J,14),J=1,83) /
 00417 1423* * .266, .262, .258, .254, .250,
 00417 1424* * .246, .243, .240, .237, .234,
 00417 1425* * .231, .228, .226, .225, .225,
 00417 1426* * .223, .221, .218, .216, .214,
 00417 1427* * .212, .210, .208, .206, .204,
 00417 1428* * .202, .200, .198, .196, .196,

00417	1429°	°	.196,	.199,	.198,	.196,	.198,
00417	1430°	°	.196,	.195,	.195,	.195,	.194,
00417	1431°	°	.194,	.194,	.194,	.194,	.194,
00417	1432°	°	.194,	.195,	.195,	.195,	.196,
00417	1433°	°	.196,	.196,	.197,	.197,	.198,
00417	1434°	°	.202,	.211,	.217,	.219,	.206,
00417	1435°	°	.194,	.187,	.181,	.177,	.175,
00417	1436°	°	.172,	.170,	.169,	.168,	.166,
00417	1437°	°	.165,	.165,	.164,	.163,	.163,
00417	1438°	°	.162,	.162,	.161,	.161,	.160,
00417	1439°	°	.160,	.160,	.160/		
00417	1440°	C					
00417	1441°	C					
00417	1442°	C					
00421	1443°						
00421	1444°		DATA (U6(J,14),J=1,83)	/			
00421	1445°	°	.395,	.395,	.395,	.395,	.395,
00421	1446°	°	.395,	.395,	.395,	.395,	.395,
00421	1447°	°	.396,	.396,	.397,	.397,	.397,
00421	1448°	°	.398,	.399,	.400,	.402,	.403,
00421	1449°	°	.405,	.408,	.411,	.414,	.418,
00421	1450°	°	.422,	.428,	.434,	.440,	.440,
00421	1451°	°	.441,	.455,	.464,	.464,	.465,
00421	1452°	°	.476,	.485,	.485,	.491,	.510,
00421	1453°	°	.512,	.512,	.529,	.543,	.543,
00421	1454°	°	.561,	.563,	.583,	.595,	.634,
00421	1455°	°	.634,	.650,	.703,	.703,	.726,
00421	1456°	°	.851,	1.040,	1.325,	1.453,	.927,
00421	1457°	°	.647,	.518,	.446,	.399,	.369,
00421	1458°	°	.347,	.329,	.316,	.305,	.296,
00421	1459°	°	.289,	.282,	.277,	.272,	.268,
00421	1460°	°	.264,	.261,	.258,	.256,	.253,
00421	1461°	°	.251,	.250,	.248/		
00421	1462°	C					
00421	1463°	C					
00421	1464°	C					
00421	1465°	C					
00423	1466°						
00423	1467°	C					
00423	1468°	C					
00423	1469°	C					
00425	1470°						
00425	1471°		DATA (U1(J,15),J=1,83)	/			
00425	1472°	°	81.76615,	81.03728,	80.32128,	79.55449,	78.80221,
00425	1473°	°	78.06401,	77.33952,	76.56968,	75.81501,	75.01875,
00425	1474°	°	74.23905,	73.47538,	72.67442,	72.28615,	72.28615,
00425	1475°	°	71.83908,	71.02273,	70.22472,	69.39625,	68.54010,
00425	1476°	°	67.65900,	66.80027,	65.91958,	64.97726,	64.06150,
00425	1477°	°	63.09148,	62.11180,	61.08736,	60.22562,	60.22562,
00425	1478°	°	60.02401,	58.92752,	57.89600,	57.89600,	57.77007,
00425	1479°	°	56.56109,	55.74136,	55.74136,	55.27916,	53.93743,
00425	1480°	°	53.76344,	53.76344,	52.49344,	51.78664,	51.78664,
00425	1481°	°	50.96840,	49.87531,	49.87531,	49.28536,	47.93864,
00425	1482°	°	47.93864,	47.41584,	45.94685,	45.94685,	45.28986,
00425	1483°	°	42.84490,	39.90423,	36.31082,	32.02049,	24.09639,
00425	1484°	°	19.63865,	17.05611,	15.32567,	14.05284,	13.05995,
00425	1485°	°	12.25054,	11.57273,	10.99263,	10.48658,	10.03915,
00425	1486°	°	9.64041,	9.28074,	8.95496,	8.65651,	8.38293,
00425	1487°	°	8.12942,	7.89453,	7.67578,	7.47105,	7.27908,

SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM O R - 1102.200 PSIA

DATA (U6(J,14),J=1,83) /

DATA UA(15) / 1175.680 /

DENSITY - LB/CU FT - FOR 1175.680 PSIA

DATA (U1(J,15),J=1,83) /

50

FOR,* TPOCB1,TPOCB1

DATE 310871 PAGE 292

00425 1487* * 7.07874, 6.92857, 6.76727/
 00425 1488*
 00425 1489* C ISOTHERM DERIVATIVE - ALL VALUES SET TO ZERO
 00425 1490* C
 00427 1491* DATA (U2(J,15),J=1,83) / 83*0. /
 00427 1492* C
 00427 1493* C ISOCORE DERIVATIVE - ALL VALUES SET TO ZERO
 00427 1494* C
 00431 1495* DATA (U3(J,15),J=1,83) / 83*0. /
 00431 1496* C
 00431 1497* C ENTHALPY - BTU/LB - FOR 1175.680 PSIA
 00431 1498* C
 00433 1499* DATA (U4(J,15),J=1,83) /
 00433 1500* * -80.121, -78.146, -76.171, -74.198, -72.225,
 00433 1501* * -70.253, -68.282, -66.310, -64.337, -62.363,
 00433 1502* * -60.388, -58.411, -56.430, -55.508, -55.508,
 00433 1503* * -54.446, -52.457, -50.463, -48.463, -46.454,
 00433 1504* * -44.437, -42.408, -40.367, -38.312, -36.239,
 00433 1505* * -34.146, -32.030, -29.886, -28.123, -28.123,
 00433 1506* * -27.710, -25.468, -23.433, -23.433, -23.185,
 00433 1507* * -20.853, -19.957, -19.957, -18.462, -15.999,
 00433 1508* * -15.683, -15.683, -13.450, -12.257, -12.257,
 00433 1509* * -10.790, -9.009, -9.009, -7.991, -5.885,
 00433 1510* * -5.885, -5.008, -2.773, -2.773, -1.774,
 00433 1511* * 1.808, 5.930, 10.813, 16.613, 28.540,
 00433 1512* * 37.175, 43.521, 48.686, 53.163, 57.193,
 00433 1513* * 60.914, 64.411, 67.736, 70.925, 74.003,
 00433 1514* * 76.990, 79.900, 82.745, 85.534, 88.274,
 00433 1515* * 90.971, 93.631, 96.238, 98.855, 101.427,
 00433 1516* * 103.975, 106.502, 109.011/
 00433 1517* C
 00433 1518* C SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 1175.680 PSIA
 00433 1519* C
 00435 1520* DATA (U5(J,15),J=1,83) /
 00435 1521* * .266, .262, .258, .254, .250,
 00435 1522* * .247, .243, .240, .237, .234,
 00435 1523* * .231, .228, .226, .225, .225,
 00435 1524* * .223, .221, .219, .216, .214,
 00435 1525* * .212, .210, .208, .206, .204,
 00435 1526* * .202, .200, .198, .196, .196,
 00435 1527* * .196, .199, .198, .198, .198,
 00435 1528* * .196, .195, .195, .195, .194,
 00435 1529* * .194, .194, .194, .194, .194,
 00435 1530* * .194, .194, .194, .194, .195,
 00435 1531* * .195, .195, .196, .196, .196,
 00435 1532* * .199, .206, .210, .214, .208,
 00435 1533* * .197, .189, .183, .179, .176,
 00435 1534* * .173, .171, .176, .168, .167,
 00435 1535* * .166, .165, .164, .164, .163,
 00435 1536* * .162, .162, .161, .161, .161,
 00435 1537* * .160, .160, .160/
 00435 1538* C
 00435 1539* C SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM O R - 1175.680 PSIA
 00435 1540* C
 00437 1541* DATA (U6(J,15),J=1,83) /
 00437 1542* * .395, .395, .395, .395, .394,
 00437 1543* * .394, .394, .394, .395, .395,
 00437 1544* * .395, .396, .396, .396, .396,

233

```

00437 15450  *      .397,      .398,      .399,      .401,      .403,
00437 15460  *      .405,      .407,      .410,      .413,      .416,
00437 15470  *      .421,      .426,      .431,      .437,      .437,
00437 15480  *      .438,      .451,      .460,      .460,      .461,
00437 15490  *      .471,      .479,      .479,      .484,      .501,
00437 15500  *      .503,      .503,      .518,      .531,      .531,
00437 15510  *      .547,      .565,      .565,      .575,      .607,
00437 15520  *      .607,      .620,      .660,      .660,      .678,
00437 15530  *      .766,      .899,      1.058,      1.241,      1.037,
00437 15540  *      .724,      .564,      .477,      .423,      .386,
00437 15550  *      .360,      .340,      .325,      .313,      .303,
00437 15560  *      .295,      .288,      .282,      .276,      .272,
00437 15570  *      .268,      .264,      .261,      .258,      .256,
00437 15580  *      .254,      .252,      .250/
00437 15590  C
00437 15600  C*****
00437 15610  C
00437 15620  C      PRESSURE = PSIA
00437 15630  C
00441 15640  C      DATA UA(161 / 1249.160 /
00441 15650  C
00441 15660  C      DENSITY = LB/CU FT = FOR 1249.160 PSIA
00441 15670  C
00443 15680  C      DATA (U1(J,16),J=1,83) /
00443 15690  *      81.83306, 81.10300, 80.38585, 79.61783, 78.86435,
00443 15700  *      78.12500, 77.33952, 76.62835, 75.81501, 75.07507,
00443 15710  *      74.29420, 73.52941, 72.72727, 72.36248, 72.36248,
00443 15720  *      71.94245, 71.12375, 70.27407, 69.44444, 68.63418,
00443 15730  *      67.75068, 66.88963, 66.00660, 65.10417, 64.18485,
00443 15740  *      63.21113, 62.22775, 61.23699, 60.40042, 60.40042,
00443 15750  *      60.20470, 59.10166, 58.09402, 58.09402, 57.97101,
00443 15760  *      56.78592, 55.99104, 55.99104, 55.52471, 54.22993,
00443 15770  *      54.05405, 54.05405, 52.85412, 52.16484, 52.16484,
00443 15780  *      51.36107, 50.32713, 50.32713, 49.75124, 48.47310,
00443 15790  *      48.47310, 47.98464, 46.62005, 46.62005, 46.04052,
00443 15800  *      43.82121, 41.25413, 38.24092, 34.71017, 27.21829,
00443 15810  *      21.97802, 18.84659, 16.78979, 15.30222, 14.15829,
00443 15820  *      13.23802, 12.47349, 11.82452, 11.26126, 10.76658,
00443 15830  *      10.32738, 9.93246, 9.57488, 9.24984, 8.95095,
00443 15840  *      8.67604, 8.42105, 8.18398, 7.96242, 7.75494,
00443 15850  *      7.56029, 7.37681, 7.20305/
00443 15860  C
00443 15870  C      ISOTHERM DERIVATIVE = ALL VALUES SET TO ZERO
00443 15880  C
00445 15890  C      DATA (U2(J,16),J=1,83) / 83.00 /
00445 15900  C
00445 15910  C      ISOCHORE DERIVATIVE = ALL VALUES SET TO ZERO
00445 15920  C
00447 15930  C      DATA (U3(J,16),J=1,83) / 83.00 /
00447 15940  C
00447 15950  C      ENTHALPY = BTU/LB = FOR 1249.160 PSIA
00447 15960  C
00451 15970  C      DATA (U4(J,16),J=1,83) /
00451 15980  *      -79.985, -78.010, -76.036, -74.064, -72.092,
00451 15990  *      -70.121, -68.151, -66.180, -64.209, -62.236,
00451 16000  *      -60.263, -58.287, -56.309, -55.388, -55.388,
00451 16010  *      -54.327, -52.341, -50.349, -48.352, -46.347,
00451 16020  *      -44.333, -42.310, -40.274, -38.224, -36.158,

```

00451	1603*	*	-34.073,	-31.966,	-29.833,	-28.079,	-28.079,
00451	1604*	*	-27.669,	-25.443,	-23.424,	-23.424,	-23.178,
00451	1605*	*	-20.867,	-19.781,	-19.781,	-18.502,	-16.072,
00451	1606*	*	-15.637,	-15.637,	-13.564,	-12.395,	-12.395,
00451	1607*	*	-10.958,	-9.224,	-9.224,	-8.232,	-6.181,
00451	1608*	*	-6.181,	-5.350,	-3.219,	-3.219,	-2.266,
00451	1609*	*	1.090,	4.835,	9.100,	14.000,	24.960,
00451	1610*	*	34.198,	41.125,	46.684,	51.437,	55.674,
00451	1611*	*	59.552,	63.173,	66.600,	69.876,	73.028,
00451	1612*	*	76.080,	79.047,	81.942,	84.775,	87.555,
00451	1613*	*	90.289,	92.982,	95.640,	98.265,	100.862,
00451	1614*	*	103.434,	106.983,	108.512/		

C
C
C

SPECIFIC HEAT CONSTANT VOLUME - BTU/LBM O R FOR 1249.160 PSIA

			DATA (U5(J,161,J=1,83) /		
00453	1618*	*	.266,	.262,	.258,
00453	1619*	*	.247,	.243,	.240,
00453	1620*	*	.231,	.229,	.226,
00453	1621*	*	.224,	.221,	.219,
00453	1622*	*	.212,	.210,	.208,
00453	1623*	*	.202,	.200,	.198,
00453	1624*	*	.196,	.199,	.198,
00453	1625*	*	.197,	.196,	.196,
00453	1626*	*	.194,	.194,	.194,
00453	1627*	*	.194,	.194,	.194,
00453	1628*	*	.194,	.194,	.194,
00453	1629*	*	.194,	.194,	.195,
00453	1630*	*	.197,	.203,	.205,
00453	1631*	*	.199,	.191,	.185,
00453	1632*	*	.174,	.172,	.171,
00453	1633*	*	.167,	.166,	.165,
00453	1634*	*	.163,	.162,	.162,
00453	1635*	*	.160,	.160,	.160/

C
C
C

SPECIFIC HEAT CONSTANT PRESSURE - BTU/LBM O R - 1249.160 PSIA

			DATA (U6(J,161,J=1,83) /		
00455	1639*	*	.395,	.395,	.394,
00455	1640*	*	.394,	.394,	.394,
00455	1641*	*	.395,	.395,	.396,
00455	1642*	*	.397,	.398,	.399,
00455	1643*	*	.404,	.406,	.408,
00455	1644*	*	.419,	.424,	.429,
00455	1645*	*	.435,	.448,	.456,
00455	1646*	*	.466,	.474,	.479,
00455	1647*	*	.496,	.496,	.509,
00455	1648*	*	.535,	.550,	.550,
00455	1649*	*	.585,	.596,	.628,
00455	1650*	*	.708,	.802,	1.048,
00455	1651*	*	.793,	.612,	.510,
00455	1652*	*	.374,	.352,	.335,
00455	1653*	*	.301,	.293,	.286,
00455	1654*	*	.271,	.267,	.264,
00455	1655*	*	.256,	.254,	.252/

C

END

TP019260
TP019270

02 JUL 71	17:51:35	01754230	14	1658	(DELETED)
02 JUL 71	17:51:35	02031504	24	1	(DELETED)
		02031534	14	747	

TPOCB1
TPOCB1 CODE SYMBOLIC
RELOCATABLE
FOR,* TPOCB2,TPOCB2

FOR,* TPOCB1,TPOCB1

3.2.56 TPOCB 2

FOR, TPOCB2, TPOCB2
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:29

31 AUG 71

9:28:29.657

BLOCK DATA

STORAGE USED (BLOCK, NAME, LENGTH)

0003 TPCB 021661

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000 I 000000 IS 0000 I 000001 J 0003 R 000000 TPCB 0003 R 020177 VB 0003 R 020230 V1
 0003 R 021030 V2

237

00100	1*	CD	*****	TP020010
00100	2*	CD		TP020020
00100	3*	CD	PROGRAMMER AND DATE	TP020030
00100	4*	CD	J. I. PREATT	TP020040
00100	5*	CD	DECEMBER 1970	TP020050
00100	6*	CD		TP020060
00100	7*	CD	PURPOSE	TP020070
00100	8*	CD	INITIALIZATION OF RODER'S THERMODYNAMIC PROPERTIES OF	TP020080
00100	9*	CD	OXYGEN	TP020090
00100	10*	CD		TP020100
00100	11*	CD	USAGE	TP020110
00100	12*	CD	BLOCK DATA	TP020120
00100	13*	CD		TP020130
00100	14*	CD	DESCRIPTION OF PARAMETERS	TP020140
00100	15*	CD		TP020150
00100	16*	CD	INPUT	TP020160
00100	17*	CD	NONE	TP020170
00100	18*	CD		TP020180
00100	19*	CD		TP020190
00100	20*	CD	OUTPUT	TP020200
00100	21*	CD	CALLING SEQUENCE	TP020210
00100	22*	CD	NONE	TP020220
00100	23*	CD	COMMON	TP020230
00100	24*	CD	VB - TEMPERATURE ARRAY - O R	TP020240
00100	25*	CD	V1 - VISCOSITY ARRAY - LBF HR/FT/FT	TP020250
00100	26*	CD	V2 - THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/O R	TP020260
00100	27*	CD		TP020270
00100	28*	CD	REMARKS AND RESTRICTIONS	TP020280
00100	29*	CD	THIS BLOCK DATA ROUTINE IS INITIALIZED EVERY TIME THE	TP020290
00100	30*	CD	SUBPROGRAM THERM IS LOADED INTO CORE.	TP020300
00100	31*	CD		TP020310
00100	32*	CD	SUBPROGRAMS REQUIRED	TP020320
00100	33*	CD	NONE	TP020330
00100	34*	CD		TP020340
00100	35*	CD	METHOD	TP020350
00100	36*	CD	REFERENCE	TP020360
00100	37*	CD	NBS LETTER ON VISCOSITY AND THERMAL CONDUCTIVITY OF	TP020370

```

00100 38* CD OXYGEN, BY H. M. RODER TO J. SMITHSON, NASA/MSC, TPC20380
00100 39* CD 20 SEPTEMBER 1970. TPC20390
00100 40* CD TPC20400
00100 41* CD ..... TPC20410
00101 42* BLOCK DATA TPC20420
00101 43* C TPC20430
00101 44* C TPC20440
00102 45* DIMENSION VB(24), V1(24,16), V2(24,16)
00102 46* C
00103 47* COMMON / TPCB / TPCB(9137)
00103 48* C
00104 49* EQUIVALENCE ( TPCB (8320) , VB )
00105 50* EQUIVALENCE ( TPCB (8345) , V1 )
00106 51* EQUIVALENCE ( TPCB (8729) , V2 )
00106 52* C TPC20520
00106 53* C TPC20530
00106 54* C ..... TPC20540
00106 55* C TPC20550
00106 56* C TEMPERATURE ARRAY FOR VISCOSITY AND THERMAL CONDUCTIVITY TPC20560
00106 57* C TPC20570
00107 58* DATA VB / TPC20580
00107 59* * 144.0000, 162.0000, 180.0000, 198.0000, 216.0000, TPC20590
00107 60* * 234.0000, 252.0000, 270.0000, 282.6000, 288.0000, TPC20600
00107 61* * 306.0000, 324.0000, 342.0000, 360.0000, 378.0000, TPC20610
00107 62* * 396.0000, 414.0000, 432.0000, 450.0000, 463.0000, TPC20620
00107 63* * 486.0000, 504.0000, 522.0000, 540.0000/ TPC20630
00107 64* C
00107 65* C .....
00107 66* C
00107 67* C VISCOSITY - LBF HR/FT/FT - FOR 14.696 PSIA
00107 68* C
00111 69* DATA (V1(J,1),J=1,24) /
00111 70* * 1.577718E-9, 1.147072E-9, .044207E-9, .048558E-9, .053432E-9,
00111 71* * .057203E-9, .061496E-9, .065673E-9, .060597E-9, .069850E-9,
00111 72* * .073911E-9, .077856E-9, .081801E-9, .085630E-9, .089343E-9,
00111 73* * .093056E-9, .096711E-9, .100250E-9, .103731E-9, .107212E-9,
00111 74* * .110576E-9, .113883E-9, .117132E-9, .120381E-9/
00111 75* C
00111 76* C THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/O R -FOR 14.696 PSIA
00111 77* C
00113 78* DATA (V2(J,1),J=1,24) /
00113 79* * .948019E-1, .874743E-1, .054783E-1, .040216E-1, .065648E-1,
00113 80* * .071080E-1, .076454E-1, .081770E-1, .085412E-1, .086972E-1,
00113 81* * .092115E-1, .097142E-1, .102112E-1, .106966E-1, .111763E-1,
00113 82* * .116501E-1, .121124E-1, .125690E-1, .130140E-1, .134589E-1,
00113 83* * .138981E-1, .143257E-1, .147534E-1, .151695E-1/
00113 84* C
00113 85* C .....
00113 86* C
00113 87* C VISCOSITY - LBF HR/FT/FT - FOR 220.440 PSIA
00113 88* C
00115 89* DATA (V1(J,2),J=1,24) /
00115 90* * 1.592454E-9, 1.167262E-9, .902887E-9, .728726E-9, .589722E-9,
00115 91* * .071532E-9, .074897E-9, .077856E-9, .080049E-9, .080989E-9,
00115 92* * .084238E-9, .087545E-9, .090851E-9, .094158E-9, .097465E-9,
00115 93* * .100772E-9, .104021E-9, .107270E-9, .110460E-9, .113651E-9,
00115 94* * .116784E-9, .119859E-9, .122934E-9, .125950E-9/
00115 95* C

```

```

00115  96*  C      THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/O R -FOR 220.440 PSIA
00115  97*  C
00117  98*      DATA (V2(J,2),J=1,24) /
00117  99*      * .952238E-1, .879455E-1, .807593E-1, .728654E-1, .637291E-1,
00117 100*      * .090439E-1, .093675E-1, .097258E-1, .099968E-1, .101130E-1,
00117 101*      * .105175E-1, .109278E-1, .113439E-1, .117657E-1, .121818E-1,
00117 102*      * .126036E-1, .130197E-1, .134300E-1, .138403E-1, .142506E-1,
00117 103*      * .146551E-1, .150597E-1, .154584E-1, .158514E-1/
00117 104*  C
00117 105*  C*****
00117 106*  C
00117 107*  C      VISCOSITY - LBF HR/FT/FT - FOR 293.920 PSIA
00117 108*  C
00121 109*      DATA (V1(J,3),J=1,24) /
00121 110*      * 1.602200E-9, 1.174456E-9, .908109E-9, .734006E-9, .594944E-9,
00121 111*      * .480306E-9, .078668E-9, .081105E-9, .083745E-9, .084876E-9,
00121 112*      * .087951E-9, .091026E-9, .094100E-9, .097233E-9, .100366E-9,
00121 113*      * .103499E-9, .106631E-9, .109764E-9, .112839E-9, .115914E-9,
00121 114*      * .118989E-9, .121948E-9, .124906E-9, .127865E-9/
00121 115*  C
00121 116*  C      THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/O R -FOR 293.920 PSIA
00121 117*  C
00123 118*      DATA (V2(J,3),J=1,24) /
00123 119*      * .953740E-1, .811389E-1, .809673E-1, .731717E-1, .640931E-1,
00123 120*      * .555115E-1, .100609E-1, .103210E-1, .105516E-1, .106504E-1,
00123 121*      * .110145E-1, .113959E-1, .117773E-1, .121702E-1, .125632E-1,
00123 122*      * .129619E-1, .133607E-1, .137594E-1, .141524E-1, .145453E-1,
00123 123*      * .149383E-1, .153255E-1, .157127E-1, .160940E-1/
00123 124*  C
00123 125*  C*****
00123 126*  C
00123 127*  C      VISCOSITY - LBF.HR/FT/FT - FOR 367.400 PSIA
00123 128*  C
00125 129*      DATA (V1(J, 4),J=1,24) /
00125 130*      * 1.611974E-9, 1.181669E-9, .913346E-9, .739298E-9, .600117E-9,
00125 131*      * .486232E-9, .086385E-9, .086038E-9, .087198E-9, .087720E-9,
00125 132*      * .090215E-9, .093174E-9, .096422E-9, .100078E-9, .103210E-9,
00125 133*      * .106169E-9, .109186E-9, .112203E-9, .115162E-9, .118178E-9,
00125 134*      * .121079E-9, .124038E-9, .126939E-9, .129782E-9/
00125 135*  C
00125 136*  C      THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/O R - FOR 367.400 PSIA
00127 137*      DATA (V2(J, 4),J=1,24) /
00127 138*      * .955269E-1, .883089E-1, .811718E-1, .734684E-1, .644589E-1,
00127 139*      * .560158E-1, .109685E-1, .109859E-1, .111303E-1, .111997E-1,
00127 140*      * .114944E-1, .118296E-1, .121879E-1, .125635E-1, .129449E-1,
00127 141*      * .133206E-1, .137020E-1, .140776E-1, .144590E-1, .148405E-1,
00127 142*      * .152219E-1, .155975E-1, .159789E-1, .163488E-1/
00127 143*  C
00127 144*  C*****
00127 145*  C
00127 146*  C      VISCOSITY - LBF.HR/FT/FT - FOR 440.880 PSIA
00127 147*  C
00131 148*      DATA (V1(J, 5),J=1,24) /
00131 149*      * 1.621721E-9, 1.188864E-9, .918509E-9, .744519E-9, .605281E-9,
00131 150*      * .491976E-9, .377104E-9, .093464E-9, .093348E-9, .093289E-9,
00131 151*      * .094218E-9, .096248E-9, .098801E-9, .101644E-9, .104719E-9,
00131 152*      * .107852E-9, .111449E-9, .114523E-9, .117424E-9, .120325E-9,
00131 153*      * .123168E-9, .126018E-9, .128854E-9, .131696E-9/

```



```

00131 154* C
00131 155* C THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/O R - FOR 440.880 PSIA
00131 156* C
00133 157* DATA (V2(J, 5), J=1, 24) /
00133 158* * .956771E-1, .884823E-1, .813741E-1, .737631E-1, .648115E-1,
00133 159* * .565013E-1, .456830E-1, .118181E-1, .118238E-1, .118296E-1,
00133 160* * .120145E-1, .122862E-1, .125924E-1, .129334E-1, .132859E-1,
00133 161* * .136499E-1, .140198E-1, .143955E-1, .147653E-1, .151352E-1,
00133 162* * .154993E-1, .158691E-1, .162332E-1, .165973E-1/
00133 163* C
00133 164* C*****
00133 165* C
00133 166* C VISCOSITY - LBF.HR/FT/FT - FOR 514.360 PSIA
00133 167* C
00135 168* DATA (V1(J, 6), J=1, 24) /
00135 169* * 1.631526E-9, 1.196058E-9, .923673E-9, .749683E-9, .610386E-9,
00135 170* * .497603E-9, .376756E-9, .102688E-9, .100658E-9, .099729E-9,
00135 171* * .099381E-9, .100832E-9, .102166E-9, .104429E-9, .106981E-9,
00135 172* * .109708E-9, .112609E-9, .115626E-9, .118643E-9, .122181E-9,
00135 173* * .125082E-9, .127983E-9, .130768E-9, .133495E-9/
00135 174* C
00135 175* C THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/O R - FOR 514.360 PSIA
00135 176* C
00137 177* DATA (V2(J, 6), J=1, 24) /
00137 178* * .958274E-1, .886499E-1, .815706E-1, .740463E-1, .651640E-1,
00137 179* * .569694E-1, .462667E-1, .129161E-1, .126791E-1, .125809E-1,
00137 180* * .126040E-1, .127774E-1, .130259E-1, .133206E-1, .136384E-1,
00137 181* * .139736E-1, .143204E-1, .146787E-1, .150370E-1, .154010E-1,
00137 182* * .157651E-1, .161292E-1, .164875E-1, .168458E-1/
00137 183* C
00137 184* C TP020640
00137 185* C***** TP020650
00137 186* C TP020660
00137 187* C VISCOSITY - LBF.HR/FT/FT - FOR 587.840 PSIA TP020670
00137 188* C TP020680
00141 189* DATA (V1(J, 7), J=1, 24) /
00141 190* * 1.641273E-9, 1.203194E-9, .930809E-9, .754846E-9, .615434E-9, TP020700
00141 191* * .503173E-9, .380121E-9, .113189E-9, .108896E-9, .107098E-9, TP020710
00141 192* * .106749E-9, .105357E-9, .106401E-9, .108142E-9, .109882E-9, TP020720
00141 193* * .112203E-9, .114756E-9, .117424E-9, .120209E-9, .123052E-9, TP020730
00141 194* * .125953E-9, .128854E-9, .132334E-9, .135119E-9/ TP020740
00141 195* C TP020750
00141 196* C THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/O R - FOR 587.840 PSIA TP020760
00141 197* C TP020770
00143 198* DATA (V2(J, 7), J=1, 24) /
00143 199* * .959690E-1, .888690E-1, .817762E-1, .743273E-1, .655088E-1, TP020790
00143 200* * .574184E-1, .469125E-1, .145800E-1, .136323E-1, .134705E-1, TP020800
00143 201* * .132740E-1, .133260E-1, .134936E-1, .137305E-1, .140079E-1, TP020810
00143 202* * .143142E-1, .146378E-1, .149672E-1, .153081E-1, .156606E-1, TP020820
00143 203* * .160074E-1, .163599E-1, .167182E-1, .170707E-1/ TP020830
00143 204* C TP020840
00143 205* C***** TP020850
00143 206* C TP020860
00143 207* C VISCOSITY - LBF.HR/FT/FT - FOR 661.320 PSIA TP020870
00143 208* C TP020880
00145 209* DATA (V1(J, 8), J=1, 24) /
00145 210* * 1.650961E-9, 1.212941E-9, .935740E-9, .760010E-9, .620481E-9, TP020900
00145 211* * .508568E-9, .385632E-9, .323671E-9, .175672E-9, .112261E-9, TP020910

```

```

00145 212* * .111507E-9, .111913E-9, .110869E-9, .111797E-9, .113537E-9, TPO20920
00145 213* * .115510E-9, .117366E-9, .119687E-9, .122182E-9, .124792E-9, TPO20930
00145 214* * .127461E-9, .130180E-9, .132973E-9, .135757E-9/ TPO20940
00145 215* C THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/D R - FOR 661.320 PSIA TPO20950
00145 216* C TPO20960
00145 217* C DATA (V2(J, 8),J=1,24) / TPO20970
00147 218* * .961019E-1, .889882E-1, .819842E-1, .746047E-1, .658498E-1, TPO20990
00147 219* * .578576E-1, .475887E-1, .378860E-1, .164523E-1, .149325E-1, TPO21000
00147 220* * .140252E-1, .139270E-1, .140021E-1, .141697E-1, .144008E-1, TPO21010
00147 221* * .146667E-1, .149614E-1, .152677E-1, .155913E-1, .159207E-1, TPO21020
00147 222* * .162616E-1, .165968E-1, .169435E-1, .172845E-1/ TPO21030
00147 223* C TPO21040
00147 224* C TPO21050
00147 225* C TPO21060
00147 226* C VISCOSITY - LBF.HR/FT/FT - FOR 734.800 PSIA TPO21070
00147 227* C TPO21080
00147 228* C DATA (V1(J, 9),J=1,24) /
00151 229* * .1660708E-9, .219380E-9, .941890E-9, .765695E-9, .625470E-9, TPO21100
00151 230* * .513906E-9, .394683E-9, .330755E-9, .191279E-9, .128099E-9, TPO21110
00151 231* * .115104E-9, .115800E-9, .116728E-9, .117366E-9, .117076E-9, TPO21120
00151 232* * .118469E-9, .120557E-9, .122508E-9, .124502E-9, .126881E-9, TPO21130
00151 233* * .129318E-9, .131870E-9, .134423E-9, .137092E-9/ TPO21140
00151 234* C TPO21150
00151 235* C THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/D R - FOR 734.800 PSIA TPO21160
00151 236* C TPO21170
00151 237* C DATA (V2(J, 9),J=1,24) /
00153 238* * .974195E-1, .891616E-1, .821865E-1, .748647E-1, .661907E-1, TPO21190
00153 239* * .582853E-1, .484324E-1, .394521E-1, .216937E-1, .166141E-1, TPO21200
00153 240* * .148747E-1, .145742E-1, .145395E-1, .146378E-1, .148111E-1, TPO21210
00153 241* * .150307E-1, .152966E-1, .155797E-1, .158802E-1, .161923E-1, TPO21220
00153 242* * .165159E-1, .168395E-1, .171689E-1, .175041E-1/ TPO21230
00153 243* C TPO21240
00153 244* C TPO21250
00153 245* C TPO21260
00153 246* C VISCOSITY - LBF.HR/FT/FT - FOR 808.280 PSIA TPO21270
00153 247* C TPO21280
00153 248* C DATA (V1(J,10),J=1,24) /
00155 249* * .1670455E-9, .1227561E-9, .948039E-9, .770220E-9, .630460E-9, TPO21300
00155 250* * .519127E-9, .401123E-9, .350591E-9, .205899E-9, .143938E-9, TPO21310
00155 251* * .123690E-9, .118643E-9, .120035E-9, .120093E-9, .122240E-9, TPO21320
00155 252* * .122008E-9, .123458E-9, .125257E-9, .127403E-9, .129492E-9, TPO21330
00155 253* * .131464E-9, .133785E-9, .136164E-9, .138658E-9/ TPO21340
00155 254* C TPO21350
00155 255* C THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/D R - FOR 808.280 PSIA TPO21360
00155 256* C TPO21370
00155 257* C DATA (V2(J,10),J=1,24) /
00157 258* * .964082E-1, .893349E-1, .823772E-1, .751248E-1, .665259E-1, TPO21390
00157 259* * .587013E-1, .490507E-1, .406252E-1, .381923E-1, .216070E-1, TPO21400
00157 260* * .158455E-1, .152908E-1, .151116E-1, .151290E-1, .152446E-1, TPO21410
00157 261* * .154237E-1, .156433E-1, .158976E-1, .161172E-1, .164697E-1, TPO21420
00157 262* * .167702E-1, .170622E-1, .174001E-1, .177237E-1/ TPO21430
00157 263* C TPO21440
00157 264* C TPO21450
00157 265* C TPO21460
00157 266* C VISCOSITY - LBF.HR/FT/FT - FOR 861.760 PSIA TPO21470
00157 267* C TPO21480
00157 268* C DATA (V1(J,11),J=1,24) /
00161 269*

```

242

```

00161 270* 01.680201E-9, 0.235799E-9, 0.954247E-9, 0.775268E-9, 0.635391E-9, TP021500
00161 271* 0.524291E-9, 0.408201E-9, 0.360395E-9, 0.241347E-9, 0.190350E-9, TP021510
00161 272* 0.137034E-9, 0.124038E-9, 0.122298E-9, 0.124154E-9, 0.124560E-9, TP021520
00161 273* 0.126823E-9, 0.126707E-9, 0.128157E-9, 0.129840E-9, 0.131870E-9, TP021530
00161 274* 0.134133E-9, 0.136164E-9, 0.138136E-9, 0.140399E-9, TP021540
00161 275* C TP021550
00161 276* C THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/O R - FOR 881.760 PSIA TP021560
00161 277* C TP021570
00163 278* DATA (V2(J,11),J=1,24) /
00163 279* 0.965527E-1, 0.895083E-1, 0.825795E-1, 0.754022E-1, 0.668553E-1, TP021590
00163 280* 0.591059E-1, 0.496748E-1, 0.416769E-1, 0.375219E-1, 0.312577E-1, TP021600
00163 281* 0.170013E-1, 0.160363E-1, 0.157126E-1, 0.156317E-1, 0.156895E-1, TP021610
00163 282* 0.158224E-1, 0.160074E-1, 0.162327E-1, 0.164754E-1, 0.167470E-1, TP021620
00163 283* 0.170360E-1, 0.173307E-1, 0.176370E-1, 0.179490E-1, TP021630
00163 284* C TP021640
00163 285* C TP021650
00163 286* C***** TP021660
00163 287* C TP021670
00163 288* C VISCOSITY - LBF.HR/FT/FT - FOR 955.240 PSIA TP021680
00163 289* C TP021690
00165 290* DATA (V1(J,12),J=1,24) /
00165 291* 01.689484E-9, 0.244095E-9, 0.960455E-9, 0.780373E-9, 0.640265E-9, TP021710
00165 292* 0.529396E-9, 0.417019E-9, 0.371186E-9, 0.284859E-9, 0.247844E-9, TP021720
00165 293* 0.145446E-9, 0.132915E-9, 0.126301E-9, 0.126069E-9, 0.128157E-9, TP021730
00165 294* 0.128854E-9, 0.131232E-9, 0.132567E-9, 0.132683E-9, 0.134365E-9, TP021740
00165 295* 0.136164E-9, 0.138310E-9, 0.140573E-9, 0.142661E-9, TP021750
00165 296* C TP021760
00165 297* C THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/O R - FOR 955.240 PSIA TP021770
00165 298* C TP021780
00167 299* DATA (V2(J,12),J=1,24) /
00167 300* 0.966914E-1, 0.896816E-1, 0.827759E-1, 0.756622E-1, 0.671847E-1, TP021800
00167 301* 0.595046E-1, 0.504261E-1, 0.425380E-1, 0.377069E-1, 0.335750E-1, TP021810
00167 302* 0.186078E-1, 0.168742E-1, 0.163483E-1, 0.161634E-1, 0.161460E-1, TP021820
00167 303* 0.162327E-1, 0.163772E-1, 0.165737E-1, 0.167933E-1, 0.170418E-1, TP021830
00167 304* 0.173018E-1, 0.175850E-1, 0.178739E-1, 0.181744E-1, TP021840
00167 305* C TP021850
00167 306* C***** TP021860
00167 307* C TP021870
00167 308* C VISCOSITY - LBF.HR/FT/FT - FOR 1028.720 PSIA TP021880
00167 309* C TP021890
00171 310* DATA (V1(J,13),J=1,24) /
00171 311* 01.697432E-9, 0.252333E-9, 0.966663E-9, 0.785363E-9, 0.645370E-9, TP021910
00171 312* 0.534385E-9, 0.425605E-9, 0.379657E-9, 0.304410E-9, 0.272211E-9, TP021920
00171 313* 0.159486E-9, 0.142255E-9, 0.132915E-9, 0.129144E-9, 0.129782E-9, TP021930
00171 314* 0.132102E-9, 0.132973E-9, 0.135409E-9, 0.136860E-9, 0.137034E-9, TP021940
00171 315* 0.138716E-9, 0.140457E-9, 0.142429E-9, 0.144634E-9, TP021950
00171 316* C TP021960
00171 317* C THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/O R - FOR 1028.720 PSIA TP021970
00171 318* C TP021980
00173 319* DATA (V2(J,13),J=1,24) /
00173 320* 0.968012E-1, 0.898146E-1, 0.829724E-1, 0.759165E-1, 0.675198E-1, TP022000
00173 321* 0.598918E-1, 0.511426E-1, 0.433008E-1, 0.384581E-1, 0.345285E-1, TP022010
00173 322* 0.206940E-1, 0.177872E-1, 0.170187E-1, 0.167124E-1, 0.166199E-1, TP022020
00173 323* 0.166488E-1, 0.167586E-1, 0.169146E-1, 0.171111E-1, 0.173423E-1, TP022030
00173 324* 0.175850E-1, 0.178450E-1, 0.181166E-1, 0.184056E-1, TP022040
00173 325* C TP022050
00173 326* C
00173 327* C*****

```

```

00173 328* C
00173 329* C VISCOSITY - LBF.HR/FT/FT - FOR 1102.20 PSIA
00173 330* C
00175 331* DATA (V1(J,14),J=1,24) /
00175 332* *1.705322E-9,1.263937E-9, .971130E-9, .790352E-9, .649895E-9,
00175 333* * .539317E-9, .433496E-9, .385864E-9, .322047E-9, .294663E-9,
00175 334* * .179153E-9, .149507E-9, .140398E-9, .134945E-9, .133379E-9,
00175 335* * .133785E-9, .135583E-9, .137556E-9, .138832E-9, .139586E-9,
00175 336* * .141849E-9, .143532E-9, .144692E-9, .146664E-9/
00175 337* C
00175 338* C THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/D R - FOR 1102.20 PSIA
00175 339* C
00177 340* DATA (V2(J,14),J=1,24) /
00177 341* * .969196E-1, .899790E-1, .831656E-1, .761672E-1, .679090E-1,
00177 342* * .602692E-1, .517972E-1, .439724E-1, .389794E-1, .355640E-1,
00177 343* * .234974E-1, .190302E-1, .177473E-1, .172908E-1, .171174E-1,
00177 344* * .170769E-1, .171405E-1, .172676E-1, .180131E-1, .176433E-1,
00177 345* * .178687E-1, .181114E-1, .183714E-1, .186430E-1/
00177 346* C
00177 347* C
00177 348* C
00177 349* C VISCOSITY - LBF.HR/FT/FT - FOR 1175.68 PSIA
00177 350* C
00201 351* DATA (V1(J,15),J=1,24) /
00201 352* *1.713212E-9,1.275540E-9, .975655E-9, .795341E-9, .654420E-9,
00201 353* * .544248E-9, .441385E-9, .392014E-9, .334810E-9, .305670E-9,
00201 354* * .198820E-9, .156d17E-9, .147940E-9, .140747E-9, .137034E-9,
00201 355* * .135525E-9, .138252E-9, .139702E-9, .140805E-9, .142139E-9,
00201 356* * .144982E-9, .146606E-9, .146897E-9, .148695E-9/
00201 357* C
00201 358* C THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/D R - FOR 1175.68 PSIA
00201 359* C
00203 360* DATA (V2(J,15),J=1,24) /
00203 361* * .970294E-1, .901466E-1, .833563E-1, .764157E-1, .682442E-1,
00203 362* * .606390E-1, .524560E-1, .446428E-1, .395168E-1, .365926E-1,
00203 363* * .263927E-1, .203594E-1, .184812E-1, .178687E-1, .175970E-1,
00203 364* * .175104E-1, .175277E-1, .176202E-1, .177646E-1, .179438E-1,
00203 365* * .181518E-1, .183772E-1, .186257E-1, .188800E-1/
00203 366* C
00203 367* C
00203 368* C
00203 369* C VISCOSITY - LBF.HR/FT/FT - FOR 1249.16 PSIA
00203 370* C
00205 371* DATA (V1(J,16),J=1,24) /
00205 372* *1.721045E-9,1.284648E-9, .981573E-9, .800273E-9, .659062E-9,
00205 373* * .549295E-9, .448464E-9, .395670E-9, .339510E-9, .315375E-9,
00205 374* * .219822E-9, .168710E-9, .153162E-9, .146897E-9, .143067E-9,
00205 375* * .139644E-9, .140051E-9, .140921E-9, .143010E-9, .144576E-9,
00205 376* * .146664E-9, .148115E-9, .149681E-9, .151480E-9/
00205 377* C
00205 378* C THERMAL CONDUCTIVITY - BTU FT/HR/FT/FT/D R - FOR 1249.16 PSIA
00205 379* C
00207 380* DATA (V2(J,16),J=1,24) /
00207 381* * .971392E-1, .903084E-1, .835470E-1, .766526E-1, .685852E-1,
00207 382* * .610031E-1, .530397E-1, .452207E-1, .401120E-1, .374421E-1,
00207 383* * .284905E-1, .219197E-1, .192440E-1, .184870E-1, .181113E-1,
00207 384* * .179554E-1, .179264E-1, .179785E-1, .180940E-1, .182500E-1,
00207 385* * .184350E-1, .186488E-1, .188800E-1, .191227E-1/

```

00211 386* END

T 060

END OF UNIVAC 1108 FORTRAN V COMPILATION.
 TPOCB2 SYMBOLIC
 TPOCB2 CODE RELOCATABLE

O *DIAGNOSTIC* MESSAGE(S)

02 JUL 71	17:51:39	0	02056066	14	386	(DELETED)
02 JUL 71	17:51:39	1	02070522	24	1	(DELETED)
		0	02070552	14	76	

@ HDG @ FOR,* TRWDAT,TRWDAT

© FOR, TRWDAT, TRWDAT
UNIVAC 1108 FORTRAN V LEVEL 2206 0018 FSO18H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:43

31 AUG 71

9:28:43.489

BLOCK DATA

STORAGE USED (BLOCK, NAME, LENGTH)

0003 STAB 000504

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000 1 000000 1 0003 1 000002 IADD 0003 1 000000 ICOUNT 0003 1 000001 ITYPE 0003 1 000004 KSYMB
0003 1 000003 LADD

245

```

00101 1* BLOCK DATA
00102 2* COMMON /STAB/ ICOUNT, ITYPE, IADD, LADD, KSYMB( 160,2)
00103 3* DATA
00103 4* * ICOUNT / 160 /, ITYPE / 18 /, IADD / 21 /, LADD / 15 /
00110 5* DATA (KSYMB(1,1), I= 1, 40)/
00110 6* * 6HMOEX ,6HNNRE ,6HNNPR ,6HEMIS
00110 7* * ,6HATHCON ,6HDELT ,6HNODEL ,6HNLC
00110 8* * ,6HICHAM ,6HNCAM ,6HNPBL ,6HNPBL
00110 9* * ,6HNVALL ,6HNJUNCL ,6HIJUNC ,6H20
00110 10* * ,6HNPBLF ,6HIPBF ,6HNLINJU ,6HVISC
00110 11* * ,6HIFB ,6HIEND ,6HLVDN ,6HLVUP
00110 12* * ,6HALPHA ,6HXLNGL ,6HTH ,6HPZOO
00110 13* * ,6H0IALO ,6HRHOL ,6HIPROP ,6HNPLINE
00110 14* * ,6HTIME ,6HTIMEND ,6HH ,6HIPUMI
00110 15* * ,6HPDELP ,6HPAG ,6HPW1 ,6HPW2
00110 16* */
00112 17* DATA (KSYMB(1,2), I= 1, 40)/
00112 18* * 0000000200001 ,0000000200002 ,0000000200003 ,0000000200004
00112 19* * ,0000000200042 ,0000000200100 ,0000000300101 ,0000000305756
00112 20* * ,0000000305764 ,0000000300147 ,0000000300150 ,0000000300151
00112 21* * ,0000000300152 ,0000000300153 ,0000000300154 ,0000000200250
00112 22* * ,0000000300251 ,0000000300252 ,0000000310122 ,0000000200254
00112 23* * ,0000000300312 ,0000000300324 ,0000000300332 ,0000000300344
00112 24* * ,0000000200356 ,0000000200414 ,0000000200452 ,0000000200510
00112 25* * ,0000000200511 ,0000000200547 ,0000000300552 ,0000000300554
00112 26* * ,0000000200612 ,0000000200613 ,0000000200614 ,0000000300640
00112 27* * ,0000000200645 ,0000000200652 ,0000000200657 ,0000000200664
00112 28* */
00114 29* DATA (KSYMB(1,1), I= 41, 80)/
00114 30* * 6HRPMD ,6HIBNDS ,6HM ,6HN
00114 31* * ,6HMAXIT ,6HIDER ,6HIFIN ,6HJVECTR
00114 32* * ,6HDIAD ,6HD1AP ,6HPWD ,6HPW1
00114 33* * ,6HPW2 ,6HATO ,6HEPSLN ,6HBOUNDS
00114 34* * ,6HTTEMP ,6HTTEMP ,6HTT ,6HKA
00114 35* * ,6HIPB ,6HWDOTG ,6HPGPBL ,6HMACH
00114 36* * ,6HRGAS ,6HNP1PL ,6HCP ,6HGEE
00114 37* * ,6HTENV ,6HRFLAG ,6HNSYS ,6HMH

```

```

00114 38*      ,6HAREAT      ,6HAREAE      ,6HCV      ,6HNCQEF
00114 39*      ,6HCTA      ,6HPATM      ,6HARINJ      ,6HTHRT
00114 40*      */
00116 41*      DATA (KSYMB(I,2),I= 41, 80)/
00116 42*      ,0000000200671 ,0000000300676 ,0000000300677 ,0000000300700
00116 43*      ,0000000300701 ,0000000300702 ,0000000300703 ,0000000300704
00116 44*      ,0000000200730 ,0000000200735 ,0000000200742 ,0000000200747
00116 45*      ,0000000200754 ,0000000200761 ,0000000200766 ,0000000200767
00116 46*      ,0000000201133 ,0000000202263 ,0000000303413 ,0000000203414
00116 47*      ,0000000303416 ,0000000203424 ,0000000204554 ,0000000204562
00116 48*      ,0000000205712 ,0000000305714 ,0000000205715 ,0000000205753
00116 49*      ,0000000205754 ,0000000205755 ,0000000306014 ,0000000206065
00116 50*      ,0000000206067 ,0000000206075 ,0000000206103 ,0000000306117
00116 51*      ,0000000306120 ,0000000206121 ,0000000206122 ,0000000206136
00116 52*      */
00120 53*      DATA (KSYMB(I,1),I= 81, 120)/
00120 54*      ,6HISP      ,6HPCI      ,6HCDC      ,6HLAMDA
00120 55*      ,6HMMW2      ,6HTC2      ,6HCS2      ,6HIS2
00120 56*      ,6HPDROP      ,6HAJ      ,6HKTHER      ,6HHE00
00120 57*      ,6HHE01      ,6HHE11      ,6HHE10      ,6HLENGTH
00120 58*      ,6HTYPE      ,6HRI      ,6HTHICK      ,6HLI
00120 59*      ,6HLO      ,6HXI      ,6HXO      ,6HFD
00120 60*      ,6HARFL      ,6HP      ,6HDT8      ,6HLT
00120 61*      ,6HDS1      ,6HDHYO      ,6HNT      ,6HRO
00120 62*      ,6HLDMI      ,6HROL      ,6HGR      ,6HVTANK
00120 63*      ,6HCP1      ,6HCP2      ,6HR1      ,6HR2
00120 64*      */
00122 65*      DATA (KSYMB(I,2),I= 81, 120)/
00122 66*      ,0000000206144 ,0000000206152 ,0000000206160 ,0000000206166
00122 67*      ,0000000206174 ,0000000206200 ,0000000206204 ,0000000206210
00122 68*      ,0000000206214 ,0000000306222 ,0000000206223 ,0000000306261
00122 69*      ,0000000306266 ,0000000306273 ,0000000306300 ,0000000206305
00122 70*      ,0000000306312 ,0000000206317 ,0000000206324 ,0000000306331
00122 71*      ,0000000306336 ,0000000206343 ,0000000206350 ,0000000306355
00122 72*      ,0000000206362 ,0000000206367 ,0000000206374 ,0000000206401
00122 73*      ,0000000206406 ,0000000206413 ,0000000306420 ,0000000206425
00122 74*      ,0000000306432 ,0000000206443 ,0000000206450 ,0000000206455
00122 75*      ,0000000206462 ,0000000206467 ,0000000206474 ,0000000206501
00122 76*      */
00124 77*      DATA (KSYMB(I,1),I= 121,159)/
00124 78*      ,6HPVENT      ,6HAVENT      ,6HLDWI      ,6HLDWO
00124 79*      ,6HCTANK      ,6HLDMD      ,6HFN      ,6HDQIN
00124 80*      ,6HHR5      ,6HHR      ,6HKLT      ,6HTTANK
00124 81*      ,6HPROU      ,6HATI      ,6HKT1      ,6HATD
00124 82*      ,6HKTD      ,6HIPUMO      ,6HCEF1      ,6HCEF2
00124 83*      ,6HTHEC      ,6HPow3      ,6HWP      ,6HDIAT
00124 84*      ,6HPRIN      ,6HPRE      ,6HVA1      ,6HVAD
00124 85*      ,6HXX      ,6HFB8      ,6HFB1      ,6HPFB
00124 86*      ,6HTFB      ,6HHGOI      ,6HHG11      ,6HSYSCOM
00124 87*      ,6HSTATE      ,6HFUNCT      ,6HTLIQ
00124 88*      */
00126 89*      DATA (KSYMB(I,2),I= 121,159)/
00126 90*      ,0000000206506 ,0000000206513 ,0000000306520 ,0000000306525
00126 91*      ,0000000206532 ,0000000306537 ,0000000306544 ,0000000206551
00126 92*      ,0000000301013 ,0000000201051 ,0000000206015 ,0000000206575
00126 93*      ,0000000306602 ,0000000206614 ,0000000206621 ,0000000206626
00126 94*      ,0000000206633 ,0000000306640 ,0000000206645 ,0000000206652
00126 95*      ,0000000206657 ,0000000206664 ,0000000206671 ,0000000206676

```

@ FOR,* TR#DAT,TR#DAT DATE 310871 PAGE 306

```
00126 96* 0,0000000306710 ,0000000206722 ,0000000306734 ,0000000306760
00126 97* 0,0000000207004 ,0000000307030 ,0000000307036 ,0000000207037
00126 98* 0,0000000207045 ,0000000307053 ,0000000307060 ,0000000007066
00126 99* 0,0000000007542 ,0000000010002 ,0000000210134
00126 100* */
00130 101* END
```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

D *DIAGNOSTIC* MESSAGE(S)

TR#DAT SYMBOLIC
TR#DAT CODE RELOCATABLE

```
31 JUL 71 23:32:00 0 01460074 14 101 (DELETED)
31 JUL 71 23:32:00 1 01462702 24 1 (DELETED)
0 01462732 14 30
```

@ HDG @ FOR,* TR#LOD,TR#LOD

FOR, * TRWLOD, TRWLOD
 UNIVAC 1108 FORTRAN V LEVEL 220 18 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:44

SUBROUTINE TRWLOD ENTRY POINT 001216

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	001231
0000	*DATA	000260
0002	*BLANK	000160
0003	STAB	000504
0004	INDATA	011610

EXTERNAL REFERENCES (BLOCK, NAME)

0005	CPDATA
0006	DP2R
0007	R20P
0010	NWDUS
0011	NI02S
0012	NI01S
0013	NERR2S
0014	NERR3S

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000	000036	10F	0001	000077	130L	0001	000126	133G	0001	000111	150L	0001	000117	160L
0001	000135	190L	0001	000161	200L	0001	000214	210L	0000	000037	220F	0001	000224	230L
0001	000226	235L	0001	000232	240L	0000	000015	250F	0001	000272	260L	0001	000311	270L
0000	000055	290F	0001	000353	300L	0000	000015	310F	0001	000367	320L	0001	000410	330L
0001	000435	340L	0001	000441	350L	0001	000460	355L	0000	000075	360F	0001	000477	370L
0001	000510	380L	0001	000527	390L	0000	000105	395F	0001	000024	40L	0001	000560	400L
0000	000114	405F	0001	000600	410L	0001	000622	420L	0001	000653	430L	0001	000736	440G
0001	000665	440L	0001	000673	450L	0001	000701	460L	0001	000720	470L	0001	000757	470L
0001	001012	500L	0001	001064	510L	0001	001067	520L	0000	000127	530F	0001	001144	534G
0001	001151	540G	0001	001077	540L	0000	000143	550F	0001	001107	560L	0000	000153	570F
0001	001130	580L	0000	000177	590F	0001	000042	60L	0001	001137	600L	0000	000212	620F
0000	000217	630F	0001	001174	640L	0001	001201	650L	0001	000052	80L	0002	R 000003	8UFF
0006	R 000000	DP2R	0000	I 000011	I	0003	I 000002	IAPD	0000	I 000007	18EG	0000	I 000025	1C
0003	I 000000	ICOUNT	0000	I 000034	IDX	0000	I 000031	IPAR	0000	I 000024	IR	0000	I 000014	IREP
0000	I 000016	ISAVE	0000	I 000032	ISLSH	0000	I 000230	ITEMP2	0003	I 000001	ITYPE	0000	I 000026	IX
0000	I 000027	IY	0000	I 000030	IZ	0000	I 000012	J	0002	I 000000	JIN	0000	I 000035	JJ
0000	I 000021	JJJ	0002	I 000001	JOVT	0000	I 000023	J1	0000	I 000015	KKK	0002	I 000002	KOUT
0002	I 000003	KRBF	0000	I 000017	KRBF1	0003	I 000004	KSYMB	0003	I 000003	LAOD	0000	I 000020	LL
0000	I 000013	NAOR	0000	I 000022	NAME	0000	I 000000	NAMTYP	0000	I 000010	NDCAS	0000	I 000033	NDX
0004	R 000000	ORIGIN	0000	R 000230	TEMP	0000	R 000230	TEMP2						

00101 1* SUBROUTINE TRWLOD (IIN, IOUT, K)
 00101 2* C.....

```

00101 30 C.....TRWLOD IS A MACHINE INDEPENDENT INPUT CONTROL ROUTINE WHICH WILL
00101 40 C.....TAKE DATA (PROCESSED BY CDDATA AND STORED IN AN INPUT BUFFER) AND
00101 50 C.....STORE IT DIRECTLY INTO CORE IN THE SPECIFIED LOCATIONS.
00101 60 C.....
00103 70 C..... DIMENSION
00103 80 C..... * BUFF(107) ,NAMTYP(7)
00103 90 C..... * TEMP2(2) ,ITEMP2(2)
00103 100 C.....
00103 110 C.....KRBF IS THE DATA STORAGE BUFFER FILLED BY CDDATA
00104 120 C..... COMMON JIN,JOUT,KOUT,KRBF(109)
00104 130 C.....
00105 140 C..... EQUIVALENCE
00105 150 C..... * (KRBF,BUFF)
00105 160 C
00105 170 C * * * * *
00105 180 C *
00105 190 C * INSERT PROGRAM SYMBOL TABLE COMMON BLOCK AND INPUT COMMON BLOCK
00105 200 C *
00105 210 C COMMON /STAB/ ICOUNT, ITYPE, IADD, LADD, KSYMB( )
00106 220 C COMMON /STAB/ ICOUNT, ITYPE, IADD, LADD, KSYMB( 320)
00106 230 C *
00106 240 C COMMON / / ORIGIN( )
00107 250 C COMMON /INDATA/ ORIGIN(5000)
00107 260 C *
00107 270 C * * * * *
00107 280 C
00107 290 C.....
00110 300 C..... EQUIVALENCE
00110 310 C..... * (TEMP2(1),ITEMP2(1),TEMP)
00110 320 C.....
00111 330 C..... DATA
00111 340 C..... * IBEG / 6HBEGIN / ,NDCAS / 6HENOCAS /
00111 350 C..... * ,(NAMTYP(I),I=1,7) / 6HSYMBOL
00111 360 C..... * ,6H REAL ,6H FIXED
00111 370 C..... * ,6HDOUBLE ,6HTYPE 5
00111 380 C..... * ,6H BCD ,6H OCTAL
00111 390 C.....
00111 400 C.....ESTABLISH I/O UNITS
00111 410 C.....JIN = INPUT UNIT
00111 420 C.....JOUT = NORMAL OUTPUT UNIT
00111 430 C.....KOUT = ERROR MESSAGE OUTPUT UNIT = JOUT UNLESS JOUT = 0
00115 440 C..... JIN = IIN
00116 450 C..... JOUT = IOUT
00117 460 C..... KOUT = JOUT
00120 470 C..... IF (JOUT.EQ.0) KOUT = 6
00120 480 C.....
00120 490 C.....SKIP TO HEAD OF PAGE
00122 500 C..... IF (JOUT.NE.0) WRITE (JOUT,10)
00125 510 C..... 10 FORMAT(1H1)
00125 520 C.....
00125 530 C.....INITIALIZATION
00125 540 C.....J IS FLAG SET AFTER FIRST LEGAL SYMBOL IS RECOGNIZED
00125 550 C.....K IS ILLEGAL INPUT FLAG
00125 560 C.....NADR IS A INFORMATION CELL CONTAINING TYPE AND SUBSCRIPT OF THE
00125 570 C.....VARIABLE, IF ZERO THE SYMBOL IS BEGIN, ENOCAS, OR AN ILLEGAL
00125 580 C.....SYMBOL.
00125 590 C.....IREP IS THE NUMBER OF REPITITIONS TO BE PERFORMED
00126 600 C..... J = 0

```

```

00127 61° K = 0
00130 62° NADR = 0
00131 63° IREP = 0
00131 64° C.....
00131 65° C.....ZERO OUT THE INPUT BUFFER
00132 66° 40 DO 50 KKK=1,109
00135 67° 50 KRBFI(KKK)= 0
00135 68° C.....
00135 69° C.....CALL CODATA TO PROCESS ONE DATA CARD AND FILL THE INPUT BUFFER
00137 70° CALL CODATA
00137 71° C.....
00137 72° C.....IF NOT A CONTINUE CARD AND THE FIRST BUFFER CELL NOT A SYMBOL TYPE
00137 73° C.....FLAG THERE IS AN ILLEGAL DATA CARD CONTAINED IN THE INPUT BUFFER.
00140 74° I=1
00141 75° IF (KRBFI(1).GT.1) IF (J) 60,580,60
00141 76° C.....
00141 77° C.....IF REPEATING, BACK BUFFER POINTER UP TO FIELD BEING REPEATED
00145 78° 60 IF (IREP) 520,80,70
00150 79° 70 IREP = IREP-1
00151 80° I = ISAVE
00152 81° GO TO 130
00153 82° 80 IF (KRBFI(1)) 640,40,90
00153 83° C.....
00153 84° C.....IF KRBFI(1) EQUAL 23 A DIMENSION INTEGER FOLLOWS DESIGNATING NUMBE
00153 85° C.....OF ROWS OR COLUMNS, FOR EXAMPLE X=/3,4/ DIMENSION X(3,4,N)
00156 86° 90 IF (KRBFI(1)-23) 150,490,100
00156 87° C.....
00156 88° C.....IF KRBFI(1) IS EQUAL TO 33 A SUBSCRIPT INTEGER FOLLOWS DESIGNATING
00156 89° C.....SUBSCRIPT LOCATION FOR EXAMPLE X=/3,4/,(1,2,2),10,6
00161 90° 100 IF (KRBFI(1)-33) 580,500,110
00161 91° C.....
00161 92° C.....IF KRBFI(1) IS EQUAL TO 43 A REPEAT INTEGER FOLLOWS DESIGNATING THE
00161 93° C.....NUMBER OF TIMES THE NEXT FIELD IS TO BE REPEATED, FOR EXAMPLE
00161 94° C.....X=/3,4/,(1,2,2),10,6,2R0.
00164 95° 110 IF (KRBFI(1)-43) 580,120,580
00167 96° 120 IREP = KRBFI(1)-1
00170 97° I = I+2
00171 98° ISAVE = I
00171 99° C.....
00171 100° C.....TEST FOR KRBFI(1) EQUAL 1(SYMBOL), 2(REAL), 3 OR LARGER
00172 101° 130 IF (KRBFI(1)-2) 520,260,140
00175 102° 140 IF (KRBFI(1)-7) 160,240,520
00200 103° 150 KRBFI = KRBFI(1)
00201 104° IF (KRBFI(1)-2) 190, 260, 160
00201 105° C.....
00201 106° C.....TEST FOR KRBFI(1) EQUAL 3(INTEGER), 4(DOUBLE PRECISION), 5 OR LARGE
00204 107° 160 IF (KRBFI(1)-4) 350,380,170
00204 108° C.....
00204 109° C.....TEST FOR KRBFI(1) EQUAL TO 6 (BCD STRING)
00207 110° 170 IF (KRBFI(1)-6) 580,440,180
00207 111° C.....
00207 112° C.....TEST FOR KRBFI(1) EQUAL 7(OCTAL INTEGER)
00212 113° 180 IF (KRBFI(1)-8) 240,580,580
00212 114° C.....
00212 115° C.....BREAK OUT THE TYPE FROM THE INFORMATION CELL (NADR)
00215 116° 190 LL = FLD(ITYPE,3,NADR)
00216 117° IF (LL.NE.1) GO TO 200
00220 118° IF (J.EQ.0) GO TO 200

```

```

00222 119. IF (KRB(1+2),NE,0) GO TO 200
00224 120. I = I+1
00225 121. JJJ = 1
00226 122. GO TO 460
00226 123. C.....
00226 124. C.....NAME IS THE BCD SYMBOL READ OFF THE DATA CARD
00227 125. 200 NAME = KRB(I+1)
00227 126. C.....
00227 127. C.....INITIALIZATION
00227 128. C.....J1 IS THE SUBSCRIPT OF THE VARIABLE
00227 129. C.....IR IS THE NUMBER OF ROW FOR A DIMENSION VARIABLE
00227 130. C.....IC IS THE NUMBER OF COLUMNS FOR A DIMENSION VARIABLE
00227 131. C.....IX IS THE X SUBSCRIPT
00227 132. C.....IY IS THE Y SUBSCRIPT
00227 133. C.....IZ IS THE Z SUBSCRIPT
00227 134. C.....IPAR IS THE SUBSCRIPT FLAG
00227 135. C.....ISLSH IS THE DIMENSION FLAG
00230 136. J1 = 0
00231 137. IR = 0
00232 138. IC = 0
00233 139. IX = 0
00234 140. IY = 0
00235 141. IZ = 0
00236 142. IPAR = 0
00237 143. ISLSH = 0
00237 144. C.....
00240 145. NADR = KRB(I+2)
00241 146. LL = FLD(ITYPE,3,NADR)
00241 147. C.....
00241 148. C.....CHECK FOR ILLEGAL INPUT SYMBOL
00242 149. IF (NADR.NE.0) GO TO 230
00242 150. C.....
00242 151. C.....THE SYMBOL IS ILLEGAL
00242 152. C.....CHECK SYMBOL FOR BEGINNING OF CASE (BEGIN)
00244 153. IF(NAME.EQ.1BEG) GO TO 235
00244 154. C.....
00244 155. C.....CHECK SYMBOL FOR END OF CASE (ENDCAS)
00246 156. IF (NAME.NE.NDCAS) GO TO 210
00250 157. GO TO 650
00250 158. C.....
00251 159. 210 WRITE (KOUT,220)NAME
00254 160. 220 FORMAT(5X,A6,23H IS AN ILLEGAL SYMBOL )
00255 161. GO TO 640
00255 162. C.....
00255 163. C.....LEGAL SYMBOL, BEGIN PROCESSING VALUES
00256 164. 230 J = 1
00257 165. 235 I = I+3
00260 166. GO TO 60
00260 167. C.....
00260 168. C.....OCTAL INTEGER, TYPE 7
00261 169. 240 IF (LL.EQ.0) GO TO 320
00263 170. IF (LL.EQ.7) GO TO 320
00265 171. IF (LL.EQ.3) GO TO 320
00267 172. IF (LL.NE.2) GO TO 560
00271 173. TEMP = KRB(I+1)
00272 174. KRB(I) = 2
00273 175. WRITE (KOUT,250)KRB(I+1),TEMP
00277 176. 250 FORMAT(5X,13HINPUT VALUE 0012,13H CONVERTED TO1PE15.7)

```

```

00300 177* GO TO 370
00300 178* C.....
00300 179* C.....REAL, TYPE 2
00300 180* C.....IF EXPECTING DOUBLE PRECISION (LL=4) WILL EXPAND REAL VALUE TO D,P
00301 181* 260 IF (LL.EQ.0) GO TO 320
00303 182* GO TO (560,320,270,400,560,560,270),LL
00303 183* C.....
00303 184* C.....IF EXPECTING AN INTEGER (LL=3 OR 7) AND THE VALUE IS A WHOLE
00303 185* C.....NUMBER CONVERT TO INTEGER, IF FRACTION AN ERROR EXIST,
00304 186* 270 IF (AMOD(BUFF(I+1),1.)) 560,280,560
00307 187* 280 TEMP = BUFF(I+1)
00310 188* KRBFI(I+1) = BUFF(I+1)
00311 189* IF (LL.EQ.7) GO TO 300
00313 190* KRBFI(I) = 3
00314 191* WRITE (KOUT,290)TEMP,KRBFI(I+1)
00320 192* 290 FORMAT(5X11HINPUT VALUE1PE15.7,13H CONVERTED TOI12)
00321 193* GO TO 320
00322 194* 300 KRBFI(I) = 7
00323 195* WRITE (KOUT,310) TEMP, KRBFI(I+1)
00327 196* 310 FORMAT(5X11HINPUT VALUE1PE15.7,15H CONVERTED TO 0012)
00330 197* 320 J1 = J1+1
00330 198* C.....
00330 199* C.....IF SUBSCRIPT FLAG IS SET = 1 COMPUTE SUBSCRIPT OF THE VARIABLE.
00331 200* IF (IPAR.EQ.0) GO TO 330
00333 201* J1 = (IY-1)* IR + IR*IC*(IZ-1) + IX
00334 202* IPAR = 0
00334 203* C.....
00334 204* C.....NDX IS THE SUBSCRIPT OF THE INPUT COMMON BLOCK
00335 205* 330 NDX = FLD(IADD,LADD,NADR) + J1-1
00336 206* ORIGIN(NDX) = BUFF(I+1)
00337 207* IF (KRBFI.EQ.4) I = I + 1
00341 208* 340 I = I+2
00342 209* GO TO 60
00342 210* C.....
00342 211* C.....INTEGER, TYPE 3
00343 212* 350 IF (LL.EQ.0) GO TO 320
00345 213* GO TO (580,355,320,355,560,560,320),LL
00346 214* 355 TEMP = KRBFI(I+1)
00347 215* KRBFI(I) = 2
00350 216* WRITE (KOUT,360)KRBFI(I+1),TEMP
00354 217* 360 FORMAT(5X11HINPUT VALUEI12.13H CONVERTED TO1PE15.7)
00355 218* 370 BUFF(I+1) = KRBFI(I+1)
00356 219* IF (LL.EQ.4) GO TO 400
00360 220* GO TO 320
00360 221* C.....
00360 222* C.....DOUBLE PRECISION, TYPE 4
00361 223* 380 IF (LL.EQ.0) GO TO 410
00363 224* GO TO (580,390,390,410,560,560,390),LL
00364 225* 390 TEMP = DP2R(BUFF(I+1))
00365 226* KRBFI(I) = 2
00366 227* WRITE (KOUT,395) KRBFI(I+1),TEMP
00372 228* 395 FORMAT(5X11HINPUT VALUEIPD24.16.13H CONVERTED TO1PE15.7)
00373 229* BUFF(I+1) = TEMP
00374 230* IF (LL.EQ.2) GO TO 320
00376 231* GO TO 270
00376 232* C.....
00376 233* C.....STORE DOUBLE PRECISION VALUE
00377 234* 400 CALL R2OP (BUFF(I+1), TEMP2)

```

```

00400 235*      *WRITE (KOUT,405) KRBF(I+1), ITEMP2(1)
00404 236*      405 FORMAT(5X,11HINPUT VALUE IS,7,13H CONVERTED TO,1PD24.16)
00405 237*      410 J1 = J1+2
00406 238*      IF (IPAR.EQ.0) GO TO 420
00410 239*      J1 = ((IY-1)*IR + IR*IC*(IZ-1) + IX)*2
00411 240*      IPAR = 0
00412 241*      420 NOX = FLD(IADD,LADD,NADR) + J1-2
00413 242*      IF (KRBF(I).EQ.4) GO TO 430
00415 243*      ORIGIN(NOX) = TEMP2(1)
00416 244*      ORIGIN(NOX+1) = TEMP2(2)
00417 245*      GO TO 340
00420 246*      430 ORIGIN(NOX) = BUFF(I+1)
00421 247*      ORIGIN(NOX+1) = BUFF(I+2)
00422 248*      I = I+3
00423 249*      GO TO 60
00423 250*      C.....
00423 251*      C.....BCD, TYPE 6
00424 252*      440 IF (LL.EQ.0) GO TO 450
00426 253*      IF (LL.NE.6) GO TO 560
00426 254*      C.....
00426 255*      C.....JJJ IS THE NUMBER OF BCD WORDS
00430 256*      450 I = I + 2
00431 257*      JJJ = KRBF(I-1)
00431 258*      C.....
00432 259*      460 IF (IPAR.EQ.0) GO TO 470
00434 260*      J1 = ((IY-1)*IR + IR*IC*(IZ-1) + IX)-1
00435 261*      IPAR = 0
00435 262*      C.....
00436 263*      470 NOX = FLD(IADD,LADD,NADR) + J1-1
00437 264*      DO 480 KKK=1,JJJ
00442 265*      IOX = NOX + KKK
00443 266*      ORIGIN(IOX)=BUFF(I)
00444 267*      480 I=I+1
00446 268*      J1 = J1 + JJJ
00447 269*      GO TO 60
00447 270*      C.....
00447 271*      C.....DIMENSION INTEGER, TYPE 23
00447 272*      C.....IF A TWO DIMENSION VARIABLE ONLY THE NUMBER OF ROWS NEED TO BE
00447 273*      C.....INPUT, BUT FOR A THREE DIMENSIONAL VARIABLE BOTH THE NUMBER OF
00447 274*      C.....ROWS AND COLUMNS HAVE TO BE INPUT. WILL NOT WORK WITHOUT SOME
00447 275*      C.....CHANGES FOR A VARIABLE DIMENSIONED GREATER THAN THREE.
00447 276*      C.....IF DIMENSION FLAG IS ON THE DIMENSION HAS ALREADY BEEN DEFINED.
00450 277*      490 IF (ISLSH.EQ.1) GO TO 540
00450 278*      C.....
00450 279*      C.....THE NUMBER OF ROWS = KRBF(I+1)
00452 280*      IR = KRBF(I+1)
00453 281*      I = I+2
00454 282*      ISLSH = 1
00455 283*      IF (KRBF(I).NE.23) GO TO 60
00455 284*      C.....
00455 285*      C.....THE NUMBER OF COLUMNS = KRBF(I+1)
00457 286*      IC = KRBF(I+1)
00460 287*      I = I+2
00461 288*      GO TO 60
00461 289*      C.....
00461 290*      C.....SUBSCRIPT INTEGER, TYPE 33
00461 291*      C.....THIS ROUTINE CHECKS ONLY TO A MAXIMUM OF THREE DIMENSIONAL, THAT
00461 292*      C.....IS ONLY X, Y, AND Z.

```

```

00461 293* C.....IF SUBSCRIPT FLAG IS ON THE SUBSCRIPTS HAVE ALREADY BEEN DEFINED;
00462 294* 500 IF (IPAR.EQ.0) GO TO 540
00464 295* IX = KRBF(I)
00465 296* I = I+2
00466 297* IF (KRBF(I).NE.33) GO TO 510
00466 298* C.....
00466 299* C.....THIS IS THE Y SUBSCRIPT,HAS THE NUMBER OF ROWS BEEN DEFINED
00470 300* IF (ISLSH.NE.1) GO TO 540
00472 301* IY = KRBF(I+1)
00473 302* I = I+2
00474 303* IF (KRBF(I).NE.33) GO TO 510
00474 304* C.....
00474 305* C.....THIS IS THE Z SUBSCRIPT,HAS THE NUMBER OF COLUMNS BEEN DEFINED
00476 306* IF (IC.EQ.0) GO TO 540
00500 307* IZ = KRBF(I+1)
00501 308* I = I+2
00502 309* 510 IPAR = 1
00503 310* GO TO 60
00503 311* C.....
00503 312* C.....ERROR MESSAGES
00503 313* C.....
00504 314* 520 WRITE (KOUT,530) I
00507 315* 530 FORMAT(5X57HERROR INVOLVING REPITITION OF DATA FIELD (SEE BUFFER W
00507 316* *ORD13,1H))
00510 317* GO TO 600
00510 318* C.....
00511 319* 540 WRITE (KOUT,550) I
00514 320* 550 FORMAT(5X35HERROR IN SUBSCRIPT (SEE BUFFER WORD13,1H))
00515 321* GO TO 600
00515 322* C.....
00516 323* 560 IDX = KRBF(I)
00517 324* WRITE (KOUT,570) NAMTYP(LL),NAMTYP(IDX),I
00524 325* 570 FORMAT(5X45HINCORRECT DATA TYPE. NO CONVERSION POSSIBLE./A11,14H
00524 326* *HAS EXPECTED,A7,31H FOUND ON CARD (SEE BUFFER WORD13,2H),)
00525 327* GO TO 600
00525 328* C.....
00526 329* 580 WRITE (KOUT,590) I
00531 330* 590 FORMAT(5X,47HILLEGAL DATA CARD CONTAINED IN BUFFER (SEE WORD13,1H)
00531 331* *)
00532 332* 600 JJ = KRBF(109)
00533 333* DO 610 KKK=1,JJ
00536 334* 610 WRITE (KOUT,620) (KRBF(KKK),IDX=1,5)
00545 335* 620 FORMAT(A11,1PE19.7,115,1PD19.7,019)
00546 336* IF (JJ.EQ.108) GO TO 640
00550 337* WRITE (KOUT,630) JJ,KRBF(108)
00554 338* 630 FORMAT(12H KRBF CELLS ,13,25H THROUGH 108 ALL CONTAIN , 13 )
00554 339* C.....
00554 340* C.....SET INPUT ERROR FLAG EQUAL 2 AND RETURN TO STATEMENT 2 TO PROCESS
00554 341* C.....THE NEXT DATA CARD.
00555 342* 640 K = 2
00556 343* IPAR = 0
00557 344* IREP = 0
00560 345* GO TO 40
00560 346* C.....
00561 347* 650 RETURN
00562 348* END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION. 0 *DIAGNOSTIC* MESSAGE(S)

6 FOR,* TRWLOD,TRWLOD

DATE .310871 PAGE 314

TRWLOD SYMBOLIC
TRWLOD CODE RELOCATABLE

14 JUN 71	15:05:35	0	01442752	14	348	(DELETED)
14 JUN 71	15:05:35	1	01454362	36	1	(DELETED)
		0	01454426	14	82	.

HOG. 3 FOR,* VALVG,VALVG

FOR, VALVG, VALVG
UNIVAC 1108 FORTRAN V LEVEL 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:48

31 AUG 71

9:28:47.975

SUBROUTINE VALVG ENTRY POINT 000405

STORAGE USED (BLOCK, NAME, LENGTH)

```
0001 *CODE 000423
0000 *DATA 000104
0002 *BLANK 000000
0003 COM 006525
0004 INDATA 011610
0005 CONS 000003
```

EXTERNAL REFERENCES (BLOCK, NAME)

```
0006 SQRT
0007 NEXP65
0010 NWDUS
0011 NI015
0012 NI025
0013 NERR35
```

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001 000070 127G	0001 000232 21L	0000 000015 30F	0000 000023 40F	0001 000364 50L
0000 R 000000 A	0003 R 000000 AREA	0003 R 000074 AREAI	0003 R 000170 AREAK	0003 R 000132 AREAO
0000 R 000001 B	0000 R 000002 C	0003 R 005060 CF	0003 R 006423 CGGTC	0003 R 006436 CGTANK
0003 R 006431 CLTANK	0003 R 005014 CONCT	0003 R 006443 CPJU	0003 R 005006 CSTAR	0003 R 006355 CVEL
0000 R 000003 D	0003 R 000036 DELXL	0003 R 000226 DIALI	0003 R 006277 DMVENT	0003 R 006360 ETAT
0005 R 000002 FB	0003 R 006370 FBPC	0003 R 006376 FBTC	0003 R 006362 FBWC	0000 R 000014 FPG2
0003 R 005111 FRL	0005 R 000001 GC	0003 R 003132 HI	0003 R 003036 HO	0003 R 003322 HRAD
0003 I 005110 ICMON	0000 I 000005 II	0000 I 000006 IPROP	0003 I 005052 ISPT	0000 I 000012 J
0000 I 000007 JJ	0003 I 003606 JUN	0004 R 003413 KA	0004 R 004561 MACH	0003 I 005066 MEX
0003 I 004756 MR	0003 I 005102 MHC	0003 I 002552 NGR	0004 I 000100 NODEL	0004 I 000553 NPLINE
0003 I 002646 NPR	0003 I 002742 NRE	0003 R 000264 PB	0003 R 004764 PC	0003 R 004772 PCN
0003 R 005074 PE	0003 R 000272 PG	0003 R 003620 PGT	0000 R 000011 PG2	0000 R 000013 PG2P
0005 R 000000 PI	0003 R 005036 PMR	0003 R 006241 POWC	0003 R 006350 POWP	0003 R 006343 POWT
0003 R 006300 PFI	0003 R 006305 PPO	0003 R 006331 PTI	0003 R 006336 PTO	0003 R 006357 R
0004 R 005754 RFLAG	0004 R 005711 RGAS	0003 R 001422 RHOG	0004 000546 RHOL	0003 R 006312 RPMT
0004 R 000000 S	0000 R 000010 T	0003 R 005044 TC	0003 R 006416 THOC	0003 R 006411 TPCG
0003 R 006404 TPCL	0004 R 001132 TTEMP	0003 R 006317 TTI	0003 R 006324 TTD	0004 R 002262 TTEMP
0003 R 003226 TRALL	0003 R 006356 U	0003 R 003416 UAO	0004 I 006757 VAD	0004 I 006733 VAI
0003 R 003512 VEL	0000 R 000004 WD	0004 R 003423 WDTG	0003 R 006265 WI	0003 R 004750 WNOZ
0003 R 006253 W0	0003 R 006361 WT	0003 R 006246 WTGC	0004 R 007003 XK	

```
00101 1* SUBROUTINE VALVG(1)
00101 2* C
00103 3* INTEGER VAI, VAD
```

```

00103 4* C
00104 5* REAL KA, MACH
00104 6* C
00105 7* DIMENSION XK(20),WDOTG(30,20),TTTEMP(30,20),KA(2),RGAS(2),VAI(20)
00105 8* , VAD(20),NPLINE(30),NODEL(20),RHOL(3),MACH(30,20)
00105 9* , TTEMP(30,20)
00105 10* C
00106 11* COMMON /COM/AREA(30),DELXL(30),AREAI(30),AREAO(30),AREAK(30)
00106 12* , DIALI(30),PB(6),PG(30,20),RHOG(30,20),NGH(30,2)
00106 13* , NPR(30,2),NRE(30,2),HO(30,2),HI(30,2),TWALL(30,2)
00106 14* , HRAD(30,2),UAO(30,2),VEL(30,2),JUN(10),PGT(30,20)
00106 15* , WNOZ(6),MR(6),PC(6),PCN(6,2),CSTAR(6),CONCT(3,6)
00106 16* , PHR(6),TC(6),ISPT(6),CF(6),MEX(6),PE(6),MAC(6),ICHON
00106 17* , FRL(30,20),POWC(5),WTGC(5),WO(10),W1(10),DMVENT,PPI(5)
00106 18* , PPO(5),RPMT(5),TT1(5),TTO(5),PTI(5),PTO(5),POWT(5)
00106 19* , POWP(5),CVEL,U,R,ETAT,WT,FBWC(6),FBPC(6)
00106 20* , FBTC(6),TPCL(5),TPCG(5),THOC(5),CGGTC(6),CLTANK(5)
00106 21* , CGTANK(5),CPJU(5,10)
00106 22* C
00107 23* COMMON /INDATA/S(5000)
00107 24* C
00110 25* COMMON /CONS/PI,GC,FB
00110 26* C
00111 27* EQUIVALENCE
00111 28* , (S(3568),XK(1)) , (S(1812),WDOTG(1,1)) , (S( 603),TTEMP(1,1))
00111 29* , (S(1804),KA(1)) , (S(3018),RGAS(1)) , (S( 364),NPLINE(1))
00111 30* , (S( 65),NODEL(1)) , (S( 359),RHOL(1)) , (S(2418),MACH(1,1))
00111 31* , (S(3548),VAI(1)) , (S(3568),VAD(1))
00111 32* , (S(1203),TTTEMP(1,1))
00111 33* , (S(3053),RFLAG)
00111 34* C
00111 35* C GAS VALVES,ORIFICES,PIPEBENDS,MANIFOLDS,INJECTORS
00111 36* C
00111 37* C BUILT-IN FUNCTIONS FOR PRESSURE EQUATION + DERIVATIVE
00112 38* F(R) = 1 - (A*B* SQRT(R**C - R**D)) / WD
00113 39* FP(R) = -.5*A*B* (C*R**(C-1.) - D*R**(D-1.))/SQRT(R**C - R**D) / WD
00113 40* C
00113 41* C GAS VALVES,MANIFOLDS
00114 42* II = VAI(1)
00114 43* C VAI = LINE CONNECTED TO INLET VALVE (1)
00115 44* IPROP = NPLINE(II)
00116 45* JJ = NODEL(II)
00117 46* WD = WDOTG(II,JJ)
00120 47* T = TTEMP(II,JJ)
00120 48* C PRESSURE DOWNSTREAM,PSIA
00121 49* A = XK(1) * PGT(II,JJ)
00122 50* B = SQRT(2.*GC*KA(IPROP)/(RGAS(IPROP)*TTTEMP(II,JJ)*(KA(IPROP)-1.)))
00123 51* C = 2. / KA(IPROP)
00124 52* D = (KA(IPROP)+1.) / KA(IPROP)
00125 53* PG2 = .8 * PG(II,JJ)
00125 54* C
00126 55* DO 20 J=1,10
00131 56* R = PG2 / PGT(II,JJ)
00132 57* IF (R.GT.1.) R = .99
00134 58* IF (R.LT.0.) R = .1
00136 59* PG2 = R * PGT(II,JJ)
00137 60* PG2P = PG2 - F(R) / FP(R) * PGT(II,JJ)
00140 61* FPG2 = F(R)

```

```

FOR,* VALVG,VALVG
00141 62* IF ( ABS(1 - 2P/PG2) .LT. 1.E-6 ) GO TO 21
00143 63* PG2 = 2P
00144 64* 20 CONTINUE
00144 65* C
00146 66* WRITE (6,30) 1
00151 67* 30 FORMAT (//4X23HNO CONVERGENCE IN VALVG ,14)
00151 68* C
00152 69* 21 CONTINUE
00153 70* II = VAD(1)
00153 71* C VAD = LINE CONNECTED VALVE DISCHARGE
00154 72* JJ = 1
00155 73* PG(II,JJ) = PG2
00156 74* WDOTG(II,JJ) = WD
00157 75* TTEMP(II,JJ) = T
00157 76* C DENSITY OF GAS
00160 77* RHOG(II,JJ) = PG(II,JJ)/(RGAS(IPROP)*TTEMP(II,JJ))*144.
00160 78* C MACH NUMBER
00161 79* MACH(II,JJ) = 4.*WDOTG(II,JJ)/(RHOG(II,JJ)*PI*DIALI(II)*2.*SQRT
00161 80* * (KA(IPROP) *GC *RGAS(IPROP) *TTEMP(II,JJ) )
00161 81* * 144.
00162 82* IF (RFLAG).SO,
00165 83* WRITE(6,40)1,IPROP,II,JJ
00165 84* *, WDOTG(II,JJ),PG(II,JJ),XK(1),KA(IPROP)
00165 85* *, RGAS(IPROP),TTEMP(II,JJ),PG2,FPG2
00165 86* *, WD,RHOG(II,JJ),PI,DIALI(II)
00165 87* *, GC,MACH(II,JJ), PGT(II,JJ), TTEMP(II,JJ), R
00214 88* 40 FORMAT (///24X13HVALVG=ROUTINE,SX,417,// 3(1P8E15.7))
00215 89* 50 CONTINUE
00216 90* RETURN
00217 91* END

```

258

END OF UNIVAC 1108 FORTRAN V COMPILATION. 0 *DIAGNOSTIC* MESSAGE(5)

VALVG	CODE	SYMBOLIC	RELOCATABLE
-------	------	----------	-------------

31 AUG 71	09:25:27
-----------	----------

0	01463576	14	91 (DELETED)
---	----------	----	--------------

1	01466170	36	1 (DELETED)
---	----------	----	-------------

0 HDG	0	FOR,* VALVL,VALYL
-------	---	-------------------

0	01466234	14	33
---	----------	----	----

3.2-60 VALVL (LIQUID VALVES)

@ FOR,* VALVL,VALVL
 UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
 THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:50

31 AUG 71

9:28:50 39

SUBROUTINE VALVL ENTRY POINT 000114

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000125
0000	*DATA	000037
0002	*BLANK	000000
0003	COM	006525
0004	INDATA	011610
0005	CONS	000003

EXTERNAL REFERENCES (BLOCK, NAME)

0006	NWDUS
0007	N1015
0010	N1025
0011	NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0000	000006	4OF	0003	R	000000	AREA	0003	R	000074	AREAI	0003	R	000170	AREAK	0003	R	000132	AREAO	
0003	R	005060	CF	0003	R	006423	CGGTC	0003	R	006436	CGTANK	0003	R	006431	CLTANK	0003	R	005014	CONCT
0003	R	006443	CPJU	0003	R	005006	CSTAR	0003	R	006355	CVEL	0003	R	000036	DELXL	0003	R	000226	DIALI
0003	R	006277	DMVENT	0003	R	006360	ETA7	0005	R	000002	FB	0003	R	006370	F8PC	0003	R	006376	F8TC
0003	R	006362	FBNC	0003	R	005111	FRL	0005	R	000001	GC	0003	R	003132	H1	0003	R	003036	HO
0003	R	003322	HRAD	0003	I	005110	ICHON	0000	I	000000	II	0000	I	000001	IPROP	0003	I	005052	ISPT
0000	I	000002	JJ	0003	I	003606	JUN	0003	I	005066	MEX	0003	I	004756	MR	0003	I	005102	MWC
0003	I	002552	NGR	0004	I	000553	NPLINE	0003	I	002646	NPR	0003	I	002742	NRE	0003	R	000264	P8
0003	R	004764	PC	0003	R	004772	PCN	0003	R	005074	PE	0003	R	000272	PG	0003	R	003620	PGT
0000	R	000005	PG2	0005	R	000000	PI	0003	R	005036	PMR	0003	R	006241	POWC	0003	R	006350	POWP
0003	R	006343	POWT	0003	R	006300	PPI	0003	R	006305	PPO	0003	R	006331	PTI	0003	R	006336	PTO
0003	R	006357	R	0003	R	001422	RHOG	0004	R	000546	RHOL	0003	R	006312	RPMT	0004	R	000000	S
0000	R	000004	T	0003	R	005044	TC	0003	R	006416	THOC	0003	R	006411	TPCG	0003	R	006404	TPCL
0004	R	001132	TTEMP	0003	R	006317	TTI	0003	R	006324	TTO	0003	R	003226	TWALL	0003	R	006356	U
0003	R	003416	UAO	0004	I	006757	VAD	0004	I	006733	VAI	0003	R	003512	VEL	0000	R	000003	WD
0004	R	003423	WDOTG	0003	R	006265	WI	0003	R	004750	WNQZ	0003	R	006253	WO	0003	R	006361	WT
0003	R	006246	WTGC	0004	R	007003	XK												

00101	1*		SUBROUTINE VALVL(I)
00101	2*	C	
00103	3*		INTEGER VAI,VAD
00103	4*	C	
00104	5*		DIMENSION XK(20),WDOTG(30,20),VAI(20),VAD(20),NPLINE(30),RHOL(3)
00104	6*		*, TTEMP(30,20)
00104	7*	C	
00105	8*		COMMON /COM/AREA(30),DELXL(30),AREAI(30),AREAO(30),AREAK(30)

```

      9*      *      *      *      *      *      *      *      *      *      *
00105      10*      *      *      *      *      *      *      *      *      *
00105      11*      *      *      *      *      *      *      *      *      *
00105      12*      *      *      *      *      *      *      *      *      *
00105      13*      *      *      *      *      *      *      *      *      *
00105      14*      *      *      *      *      *      *      *      *      *
00105      15*      *      *      *      *      *      *      *      *      *
00105      16*      *      *      *      *      *      *      *      *      *
00105      17*      *      *      *      *      *      *      *      *      *
00105      18*      *      *      *      *      *      *      *      *      *
00105      19*      C      *      *      *      *      *      *      *      *
00106      20*      *      *      *      *      *      *      *      *      *
00106      21*      C      *      *      *      *      *      *      *      *
00107      22*      *      *      *      *      *      *      *      *      *
00107      23*      C      *      *      *      *      *      *      *      *
00110      24*      *      *      *      *      *      *      *      *      *
00110      25*      *      *      *      *      *      *      *      *      *
00110      26*      *      *      *      *      *      *      *      *      *
00110      27*      *      *      *      *      *      *      *      *      *
00110      28*      C      *      *      *      *      *      *      *      *
00110      29*      C      *      *      *      *      *      *      *      *
00111      30*      *      *      *      *      *      *      *      *      *
00111      31*      C      *      *      *      *      *      *      *      *
00112      32*      *      *      *      *      *      *      *      *      *
00113      33*      *      *      *      *      *      *      *      *      *
00114      34*      *      *      *      *      *      *      *      *      *
00115      35*      *      *      *      *      *      *      *      *      *
00115      36*      C      *      *      *      *      *      *      *      *
00116      37*      *      *      *      *      *      *      *      *      *
00117      38*      *      *      *      *      *      *      *      *      *
00117      39*      C      *      *      *      *      *      *      *      *
00120      40*      *      *      *      *      *      *      *      *      *
00121      41*      *      *      *      *      *      *      *      *      *
00122      42*      *      *      *      *      *      *      *      *      *
00123      43*      *      *      *      *      *      *      *      *      *
00124      44*      *      *      *      *      *      *      *      *      *
00124      45*      *      *      *      *      *      *      *      *      *
00124      46*      *      *      *      *      *      *      *      *      *
00141      47*      *      *      *      *      *      *      *      *      *
00142      48*      *      *      *      *      *      *      *      *      *
00143      49*      *      *      *      *      *      *      *      *      *

```

END OF UNIVAC 1100 FORTRAN V COMPILATION.

O *DIAGNOSTIC* MESSAGE(S)

VALVL
VALVL CODE SYMBOLIC
RELOCATABLE

31 AUG 71	09:25:29	0	01467152	14	49	(DELETED)
31 AUG 71	09:25:29	1	01470430	36	1	(DELETED)
		0	01470474	14	11	

@ HDG @ FOR,* WRITE,WRITE

3.2.61 WRITE (HEAT EXCHANGER OUTPUT PROCESSOR)

FOR, WRITE,WRITE
UNIVAC 1108 FORTRAN V LEVEL 2204 0018 F5018H
THIS COMPILATION WAS DONE ON 31 AUG 71 AT 09:28:51

31 AUG 71

9:28:51.396

SUBROUTINE WRITE ENTRY POINT 000527

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000547
0000	*DATA	000140
0002	*BLANK	000000
0003	HEAT	001074

EXTERNAL REFERENCES (BLOCK, NAME)

0004	NWDUS
0005	NIDIS
0006	NIOZS
0007	NERR2S
0010	NERR3S

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0001	000023	110L	0001	000142	120L	0001	000145	125L	0001	000166	130L	0001	000101	131G	
0001	000171	135L	0001	000212	140L	0001	000270	212G	0001	000401	231G	0001	000433	300L	
0001	000313	400L	0000	000066	9904F	0000	000052	9905F	0000	000061	9906F	0000	000077	9907F	
0000	I	000000	ANAM	0003	R	000002	CP1	0003	R	000027	CP0	0003	R	000054	DIST
0003	R	000720	HI	0003	R	000772	HO	0003	R	000745	HW	0000	I	000050	I
0000	I	000035	JIN	0000	I	000036	JOUT	0003	I	000126	K1	0003	I	000153	K0
0000	I	000051	KRET1	0003	I	000200	KW	0000	I	000037	L1	0000	I	000040	L2
0000	I	000042	L4	0000	I	000043	L5	0000	I	000044	L6	0000	I	000045	L7
0003	I	000225	MUI	0003	I	000252	MU0	0003	R	001071	PH11	0003	R	001072	PH12
0003	R	000277	PI	0003	R	000324	P0	0003	R	000351	PR1	0003	R	000376	PRO
0003	R	001017	QUAL1	0003	R	001044	QUAL0	0003	R	000450	RE1	0003	R	000475	RE0
0003	R	000547	SV0	0003	R	000574	T1	0003	R	000621	T0	0003	R	000646	TW1
0003	R	000002	VAR	0003	R	000000	WD					0003	R	000673	TW0

00101	1*	SUBROUTINE WRITE
00101	2*	CC
00101	3*	CC
00103	4*	INTEGER ANAM
00103	5*	C
00104	6*	DIMENSION ANAM(28), VAR(21,27)
00104	7*	C
00105	8*	COMMON /HEAT/WD(2),CP1(21),CP0(21),DIST(21),HE(21),KI(21),K0(21)
00105	9*	1, KA(21),MUI(21),MU0(21),PI(21),P0(21),PR1(21),PH0(21)
00105	10*	2, W(21),REI(21),RE0(21),SV1(21),SV0(21),T1(21),T0(21)
00105	11*	3, TA1(21),TW0(21),HI(21),HW(21),HO(21)
00105	12*	4, QUAL1(21), QUAL0(21)
00105	13*	4, PH11,PH12,PH13

```

00105 14* C DATA ANAM/INS,6HCP OUT,6HDIST ,6HEQ HE ,6HCOND 1,6HCOND 0
00106 15*      ,6HCOND 0,6HISC 1,6HVISC 0,6HPRES 1,6HPRES 0,6HPR. IN,6HPR OU
00106 16*      ,6HQ-IN ,6HRE. IN,6HRE. OU,6HSVOL 1,6HSVOL 0
00106 17*      ,6HTENP 1,6HTEMP 0,6HTHALLI,6HTHALLO,6HHIFILM,6HKALL H,6HHOFILM,
00106 18*      ,6HQUAL 1,6HQUAL 0, 6H
00110 19* DATA JIN,JOUT/5,6/
00113 20* EQUIVALENCE (VAR(1,1),CPI(1))
00114 21* L1=3
00115 22* L2=19
00116 23* L3=20
00117 24* L4= 4
00120 25* L5=14
00121 26* L6=10
00122 27* L7=11
00123 28* L8 = 28
00124 29* KRET=1
00125 30* GO TO 300
00126 31* 110 CONTINUE
00127 32* WRITE(JOUT,9905) (VAR(1,L1),VAR(1,L2),VAR(1,L3),VAR(1,L4),
00127 33* 1 VAR(1,L5),VAR(1,L6),VAR(1,L7),I=1,21)
00143 34* 9905 FORMAT(F14.2,F15.2,F15.2,E15.6,E15.6,2F15.2)
00144 35* L2=1
00145 36* L3=8
00146 37* L4=5
00147 38* L5=17
00150 39* L6=12
00151 40* L7=15
00152 41* L8 = 26
00153 42* KRET=2
00154 43* GO TO 300
00155 44* 120 CONTINUE
00156 45* KRET=1
00157 46* GO TO 400
00160 47* 125 CONTINUE
00161 48* L2=2
00162 49* L3=9
00163 50* L4=6
00164 51* L5=18
00165 52* L6=13
00166 53* L7=16
00167 54* L8 = 27
00170 55* KRET=3
00171 56* GO TO 300
00172 57* 130 CONTINUE
00173 58* KRET=2
00174 59* GO TO 400
00175 60* 135 CONTINUE
00176 61* L2=7
00177 62* L3=21
00200 63* L4=22
00201 64* L5=23
00202 65* L6=24
00203 66* L7=25
00204 67* L8 = 28
00205 68* KRET=4
00206 69* GO TO 300
00207 70* 140 CONTINUE
00207 71*

```

FOR, WRITE, WRITE

DATE 310871 PAGE 322

```

00210 72* WRITE(JOUT,9906) (VAR(I,L1),VAR(I,L2),VAR(I,L3),VAR(I,L4),
00210 73* 1 VAR(I,L5),VAR(I,L6),VAR(I,L7),I=1,21)
00224 74* 9906 FORMAT(F14.2,E15.6,2F15.2,3E15.6)
00225 75* 999 RETURN
00226 76* 400 CONTINUE
00227 77* WRITE(JOUT,9904) (VAR(I,L1),VAR(I,L2),VAR(I,L3),VAR(I,L4),
00227 78* 1 VAR(I,L5),VAR(I,L6),VAR(I,L7),VAR(I,L8),I=1,21)
00244 79* 9904 FORMAT (F14.2,F15.4,E15.6,E15.6, F15.3,F15.4,E15.6,F15.4)
00245 80* GO TO (125,135),KRET1
00246 81* 300 CONTINUE
00247 82* WRITE(JOUT,9907) ANAM(L1),ANAM(L2),ANAM(L3),ANAM(L4),ANAM(L5),
00247 83* 1 ANAM(L6),ANAM(L7),ANAM(L8)
00261 84* 9907 FORMAT (1H1,8(SX,A6,4X)/)
00262 85* GO TO (110,120,130,140),KRET
00263 86* END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

DIAGNOSTIC MESSAGE(S)

WRITE SYMBOLIC
WRITE CODE RELOCATABLE

14 JUN 71 15:05:19
14 JUN 71 15:05:19

0 01437304
1 01441570
0 01441620

14 06 (DELETED)
24 1 (DELETED)
14 43

BN HDG

BLANK COMMON 163620 163777
 STARTING ADDRESS 014000
 CORE LIMITS 014000 063617 064671 163611 163612 163617

SSPIPE/CODE
 0 064671-076257
 1 014000-014232

NTERS /CODE
 0 076260-076260
 1 014233-014533
 2 076261-076352

NFMTs /CODE
 1 014534-015417
 2 076353-076366

NFTVs /CODE
 1 015420-015442

NCNVTs/CODE
 1 015443-015652
 2 076367-076452

NOTINs/CODE
 1 015653-016261
 2 076453-076515

FPACKs/CODE
 1 016262-016325

DEPTH /*****
 0 076516-076523

NERRs /CODE
 0 076524-076664
 1 016326-016734

NIOINs/CODE
 1 016735-017003

2 076665-076715

NQUTS /CODE

0 076716-076722

1 017004-017675

2 076723-076740

NTABS /CODE

0 076741-077074

QMSFIL/CODE

0 077075-077114

1 017676-020001

FMERR /CODE

0 077115-077116

1 020002-020012

NBDCVS/CODE

0 077117-077303

NSTOPs/CODE

1 020013-020030

OUTPRC/CODE

0 077304-100035

1 020031-022373

WRITE /CODE

0 100036-100175

1 022374-023142

HEAT /*****

0 100176-101271

TKOUT /*****

0 101272-101365

BEGS /CODE

0 101366-101611

1 023143-025346

LEGS /CODE

0 101612-101766

1 025347-027151

ALOG /CODE

1 027152-027233

2 101767-102035

TRVL00/CODE

0 102036-102315

1 027234-030464

R2DP /CODE

0 102316-102323

1 030465-030501

DP2R /CODE
0 102324-102332
1 030502-030514

CODATA/CODE
0 102333-102634
1 030515-032521

NEXP95/CODE
1 032522-032607
2 102635-102637

NXPDS/CODE
1 032610-032752
2 102640-102656

DEXP /CODE
1 032753-033040
2 102657-102733

DLOG /CODE
1 033041-033102
2 102734-103017

MESG3 /CODE
2 103020-103027

NXPDS/CODE
1 033103-033123
2 103030-103034

MESG12/CODE
2 103035-103054

NINPTS/CODE
0 103055-103056
1 033124-034043
2 103057-103111

NININs/CODE
1 034044-034211
2 103112-103142

PACK /CODE
0 103143-103207
1 034212-034373

SQZ6 /CODE
0 103210-103227
1 034374-034472

BCDINT/CODE
0 103230-103262
1 034473-034602

STAB /*****
0 103263-103766

GATHER/CODE

0 103767-104216
1 034603-036071

FEEDB /CODE

0 104216-104243
1 036072-036155

VALVL /CODE

0 104244-104302
1 036156-036302

VALVG /CODE

0 104303-104406
1 036303-036725

NEXP65/CODE

1 036726-036737
2 104407-104407

NXPAF5/CODE

1 036740-037062
2 104410-104414

NXPAX5/CODE

1 037063-037105
2 104415-104415

EXP /CODE

1 037106-037176
2 104416-104435

SQRT /CODE

0 104436-104472
2 104473-104534

PREG /CODE

0 104535-104600
1 037177-037364

TANKD /CODE

0 104601-105146
1 037365-040100

TANK /CODE

0 105147-105234
1 040101-040402

INTEG /CODE

0 105235-105252
1 040403-040470

BETA /CODE

0 105253-105305
1 040471-040646

INITAL/CODE

0 105306-105335

I 040647-040730

GAMMA /*****
0 105336-105362

ARRAY /*****
0 105363-105431

HPTD /CODE
0 105432-107640
1 040731-041501

THERM /CODE
0 107641-107756
1 041502-043116

BINSER/CODE
0 107757-110001
1 043117-043310

TPCB /*****
0 110002-131662

HEATX /CODE
0 131663-131724
1 043311-043732

PERFOR/CODE
0 131725-132316
1 043733-044430

CHOICE/CODE
0 132317-132355
1 044431-045310

HEATEX/CODE
0 132356-132567
1 045311-047643

CHALL /CODE
0 132570-132577
1 047644-047661

NUSLET/CODE
0 132600-132704
1 047662-050037

INTER2/CODE
0 132705-132774
1 050040-050473

INTERP/CODE
0 132775-133020
1 050474-051001

BPROP6/CODE
0 133021-133206
1 051002-051213

HPTTC /CODE
0 133207-134502
1 051214-051724

HPTV /CODE
0 134503-136106
1 051725-052412

HPTCP /CODE
0 136107-136116
1 052413-052436

PTHEAT/CODE
0 136117-136452
1 052437-053264

SPHEAT/*****
0 136453-141104

BPROPL/CODE
0 141105-141272
1 053265-053476

LATENT/CODE
0 141273-141474
1 053477-053573

SAT /CODE
0 141475-141626
1 053574-053645

PROPTY/CODE
0 141627-141643
1 053646-054063

H2OH2 /CODE
0 141644-141746
1 054064-054224

CHON /CODE
0 141747-142062
1 054225-055363

HPTCV /CODE
0 142063-142072
1 055364-055407

CHAM /CODE
0 142073-142220
1 055410-057206

NEXPSS/CODE
1 057207-057264
2 142221-142223

CCPCX /*****
0 142224-142232

JUNCL /CODE
0 142233-142341
1 057265-057706

ISOTH /CODE
0 142342-142430
1 057707-060323

FCOMP2/CODE
0 142431-142501
1 060324-060506

ADIA8 /CODE
0 142502-142566
1 060507-061147

FCOMP3/CODE
0 142567-142642
1 061150-061373

PIPL /CODE
0 142643-143032
1 061374-062604

SINCOS/CODE
1 062605-062674
2 143033-143066

FCOMP1/CODE
0 143067-143152
1 062675-063134

PBL /CODE
0 143153-143251
1 063135-063617

COM /*****
0 143252-151776

CONS /*****
0 151777-152001

INDATA/*****

3.6.62 FEEDB (FEED BACK CONSTRAINTS)

UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON-08 SEP 71 AT 14:22:44

SUBROUTINE FEEDB ENTRY POINT 000054

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000064
0000	*DATA	000026
0002	*BLANK	000000
0003	INDATA	011610
0004	COM	006525

EXTERNAL REFERENCES (BLOCK, NAME)

0005 NERR3\$

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0004 R 000000 AREA	0004 R 000074 AREA1	0004 R 000170 AREAK	0004 R 000132 AREA0	0004 R 000060 CF
0004 R 006423 CGGTC	0004 R 006436 CGTANK	0004 R 006431 CLTANK	0004 R 005014 CONCT	0004 R 006443 CPJU
0004 R 005006 CSTAR	0004 R 006356 CVEL	0004 R 000036 DELXL	0004 R 000226 DIAL1	0004 R 006277 DMVENT
0004 R 006360 EYAT	0003 I 007027 FBD	0003 I 007035 FBI	0004 R 006370 FBPC	0004 R 006376 FBTC
0004 R 006362 FBWC	0004 R 005111 FRL	0004 R 003132 HI	0004 R 003036 HO	0004 R 003322 HRAD
0004 I 005110 ICMON	0000 I 000000 II	0004 I 005052 ISPT	0000 I 000001 JJ	0004 I 003606 JUN
0004 I 005066 MEX	0004 I 004756 MR	0004 I 005102 MWC	0004 I 002552 NGR	0003 I 000100 NODEL
0004 I 002646 NPR	0004 I 002742 NRE	0000 R 000003 P	0004 R 000264 PB	0004 R 004764 PC
0004 R 004772 PCN	0004 R 005074 PE	0004 R 000272 PG	0004 R 003620 PGT	0004 R 005036 PMR
0004 R 006241 POWC	0004 R 006350 POWP	0004 R 006343 POWT	0004 R 006300 PPI	0004 R 006305 PPO
0004 R 006331 PTI	0004 R 006336 PTO	0004 R 006357 R	0004 R 001422 RHOG	0004 R 006312 RPMT
0003 R 000000 S	0000 R 000004 T	0004 R 005044 TC	0004 R 006416 THOC	0004 R 006411 TPCG
0004 R 006404 TPCL	0003 R 001132 TTEMP	0004 R 006317 TTI	0004 R 006324 TTD	0004 R 003226 TWALL
0004 R 006356 U	0004 R 003416 UAO	0004 R 003512 VEL	0000 R 000002 W	0003 R 003423 WDOTG
0004 R 006265 WI	0004 R 004750 WNOZ	0004 R 006253 WO	0004 R 006361 WT	0004 R 006246 WTGC

```

00101 1* SUBROUTINE FEEDB(I)
00103 2* INTEGER FBO, FBI
00103 3* C FEEDBACK SUBROUTINE ACCOUNTS FOR DOWNSTREAM COMPONENTS CONNECTED
00103 4* C TO UPSTREAM COMPONENTS - DEFINES CONNECTIONS/CONSTRAINTS
00104 5* DIMENSION FBI(6),NODEL(30),WDOTG(30,20),FBD(6), TTEMP(30,20)
00105 6* EQUIVALENCE
00105 7* * (S( 65),NODEL) , (S(1812),WDOTG(1,1)) , (S(3608),FBD)
00105 8* * , (S(603),TTEMP(1,1)) , (S(3614),FBI)
00105 9* C
00106 10* COMMON /INDATA/S(5000)
00106 11* C
00107 12* COMMON /COM/AREA(30),DELXL(30),AREA1(30),AREA0(30),AREAK(30)
00107 13* * , DIAL1(30),PB(6),PG(30,20),RHOG(30,20),NGR(30,2)
00107 14* * , NPR(30,2),NRE(30,2),HO(30,2),HI(30,2),TWALL(30,2)

```


3.6.62 FEEDB (FEED BACK CONSTRAINTS)

UNIVAC 1108 FORTRAN V LEVEL 2206 0018 F5018H
THIS COMPILATION WAS DONE ON 08 SEP 71 AT 14:22:44

SUBROUTINE FEEDB ENTRY POINT 000054

STORAGE USED (BLOCK, NAME, LENGTH)

0001	*CODE	000064
0000	*DATA	000026
0002	*BLANK	000000
0003	INDATA	011610
0004	COM	006525

EXTERNAL REFERENCES (BLOCK, NAME)

0005 NERR35

STORAGE ASSIGNMENT FOR VARIABLES (BLOCK, TYPE, RELATIVE LOCATION, NAME)

0004 R 000000 AREA	0004 R 000074 AREA1	0004 R 000170 AREAK	0004 R 000132 AREA0	0004 R 005060 CF
0004 R 006423 CGGTC	0004 R 006436 CGTANK	0004 R 006431 CLTANK	0004 R 005014 CONCT	0004 R 006443 CPJU
0004 R 005006 CSTAR	0004 R 006355 CVEL	0004 R 000036 DELXL	0004 R 000226 DIALI	0004 R 006277 DMVENT
0004 R 006360 ETAI	0003 I 007027 FBD	0003 I 007035 FBI	0004 R 006370 FBPC	0004 R 006376 FBTC
0004 R 006362 FBWC	0004 R 005111 FRL	0004 R 003132 HI	0004 R 003036 HO	0004 R 003322 HRAD
0004 I 005110 ICMON	0000 I 000000 II	0004 I 005052 ISPT	0000 I 000001 JJ	0004 I 003606 JUN
0004 I 005066 MEX	0004 I 004756 MR	0004 I 005102 MWC	0004 I 002552 NGR	0003 I 000100 NODEL
0004 I 002646 NPR	0004 I 002742 NRE	0000 R 000003 P	0004 R 000264 PB	0004 R 004764 PC
0004 R 004772 PCN	0004 R 005074 PE	0004 R 000272 PG	0004 R 003620 PGT	0004 R 005036 PMR
0004 R 006241 POWC	0004 R 006350 POWP	0004 R 006343 POWT	0004 R 006300 PPI	0004 R 006305 PPO
0004 R 006331 PTI	0004 R 006336 PTO	0004 R 006357 R	0004 R 001422 RHOG	0004 R 006312 RPMT
0003 R 000000 S	0000 R 000004 T	0004 R 005044 TC	0004 R 006416 THOC	0004 R 006411 TPCG
0004 R 006404 TPCL	0003 R 001132 TTEMP	0004 R 006317 TTI	0004 R 006324 TTO	0004 R 003226 TWALL
0004 R 006356 U	0004 R 003416 UAO	0004 R 003512 VEL	0000 R 000002 W	0003 R 003423 WDOTG
0004 R 006265 WI	0004 R 004750 WNOZ	0004 R 006253 WO	0004 R 006361 WT	0004 R 006246 WTGC

```

00101 1* SUBROUTINE FEEDB(I)
00103 2* INTEGER FBD, FBI
00103 3* C FEEDBACK SUBROUTINE ACCOUNTS FOR DOWNSTREAM COMPONENTS CONNECTED
00103 4* C TO UPSTREAM COMPONENTS - DEFINES CONNECTIONS/CONSTRAINTS
00104 5* DIMENSION FBI(6), NODL(30), WDOTG(30,20), FBD(6), TTEMP(30,20)
00105 6* EQUIVALENCE
00105 7* * (S(65), NODL) , (S(1812), WDOTG(1,1)) , (S(3608), FBD)
00105 8* * , (S(603), TTEMP(1,1)) , (S(3614), FBI)
00105 9* C
00106 10* COMMON /INDATA/S(5000)
00106 11* C
00107 12* COMMON /COM/AREA(30), DELXL(30), AREA1(30), AREA0(30), AREAK(30)
00107 13* * , DIALI(30), PB(6), PG(30,20), RHOG(30,20), NGR(30,2)
00107 14* * , NPR(30,2), NRE(30,2), HO(30,2), HI(30,2), TWALL(30,2)

```

```

00107 15*      *,      HRAD(30,2),UAO(30,2),VEL(30,2),JUN(10),PGT(30,20)
00107 16*      *,      T(6),HR(6),PC(6),PCN(6,2),CSTAR(6),CONCT(3,6)
00107 17*      *,      TC(6),ISPT(6),CF(6),HMX(6),PE(6),MWC(6),LCHON
00107 18*      *,      FVL(30,20),POWC(5),WTGC(5),WD(10),WI(10),DMVENT,PPI(5)
00107 19*      *,      PPO(5),RPM(5),TT(5),TTO(5),PTI(5),PTO(5),POWT(5)
00107 20*      *,      POWP(5),CVEL,U,R,ETAT,WT,FBWC(6),FBPC(6)
00107 21*      *,      FBTC(6),TPCL(5),TPCG(5),THOC(5),CGGTC(6),CLTANK(5)
00107 22*      *,      CGTANK(5),CPJU(5,10)

```

```

00107 23*      C
00107 24*      C FBD = LINE CONNECTED TO FEEDBACK SUBROUTINE, UPSTREAM LINE
00110 25*      II = FBI(1)
00111 26*      JJ = NODEL(11)
00112 27*      W = WDOTG(11,JJ)
00113 28*      P = PG(11,JJ)
00114 29*      T = TTEMP(11,JJ)
00114 30*      C WFB = LINE CONNECTED TO FEEDBACK SUBROUTINE,DOWNSSTREAM LINE
00115 31*      II = FBD(1)
00116 32*      JJ = 1
00116 33*      C FBWC = FLOWRATE FEEDBACK CONSTRAINT
00117 34*      FBWC(1) = 1.0 - WDOTG(11,JJ)/ W
00117 35*      C FBPC = PRESSURE FEEDBACK CONSTRAINT
00120 36*      FBPC(1) = 1.0 - PG(11,JJ)/ P
00120 37*      C FBTC = TEMPERATURE FEEDBACK CONSTRAINT
00121 38*      FBTC(1) = 1.0 - TTEMP(11,JJ)/ T
00122 39*      RETURN
00123 40*      END

```

END OF UNIVAC 1108 FORTRAN V COMPILATION.

D *DIAGNOSTIC* MESSAGE(S)

FEEDB SYMBOLIC
FEEDB CODE RELOCATABLE

30 JUN 71	20:46:28	0	01731004	14	40 (DELETED)
30 JUN 71	20:46:28	1	01732064	24	1 (DELETED)
		0	01732114	14	7

4. REFERENCE INFORMATION

1. P. F. Thompson, T. J. Walsh, "Characterization of Attitude Control Propulsion Systems, MSC/TRW Task 705-1," TRW Technical Report 1761B - H179-RO-00, June 1971.
2. P. F. Thompson, R. C. Turley, "Steady-State Attitude Control Propulsion Systems Computer Program Documentation and User's Manual," TRW Technical Report 1761B-H179-RO-00, Volume I.

A Reproduced Copy
OF

Reproduced for NASA
by the
NASA Scientific and Technical Information Facility